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ARCHIVES OF SURGERY

VOLUME 50 FEBRUARY 1945 NUMBER 2

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TESTICULAR TUMORS

MAJOR VINCENT VERMOOTEN

MEDICAL CORPS, ARMY OF THE UNITED STATES

During the past two years, 62 soldiers with testicular tumors were admitted to the Brooke General Hospital for treatment. A statistical analysis of this rather large series of tumors has been made, the results of which stress the need for careful and routine examination of the scrotal contents. The difficulty of differentiating by clinical examination alone between a benign and a malignant growth involving the testis is also emphasized.

INCIDENCE

In civilian practice testicular tumors are encountered rather infrequently. Hinman and Smith [1] stated that they are rare and comprise only about 0.57 per cent of all malignant tumors, while Dean [2] claimed that they "constitute 2.09 per cent of all malignant tumors in the male." In contrast, it was found that "testicular tumors constituted 7.2 per cent of all malignant neoplasms occurring in white enlisted personnel of the United States Army for the calendar year 1941." [3] This difference is great, even when one takes into consideration the age of the army personnel. There seem to be several factors associated with the routine of army life which may contribute to this marked difference in incidence.

In analyzing the case histories of the 62 patients with tumors of the testis in this series I found that 10 of the tumors were accidentally discovered by soldiers while they were soaping themselves in a shower bath. Hikes, calisthenics, participation in events on obstacle courses and other military training drew the attention of 11 other soldiers to the presence of large, swollen or painful testes, which later proved to be due to tumors. Fourteen of the 62 tumors were discovered incidentally by medical officers while they were doing routine physical examination. On the other hand, only 9 were discovered as the direct result of trauma. In some instances, the soldier knew that his testis was large, hard or heavy, but, as it had not bothered him, caused him any pain or in any other way interfered with his duties, he had not reported the fact. Thus, were it not for the routine physical examinations and the routine of army life, the early treatment of 35 of these 62 tumors, excluding the 9 associated with direct trauma, might have been considerably delayed (chart 1).

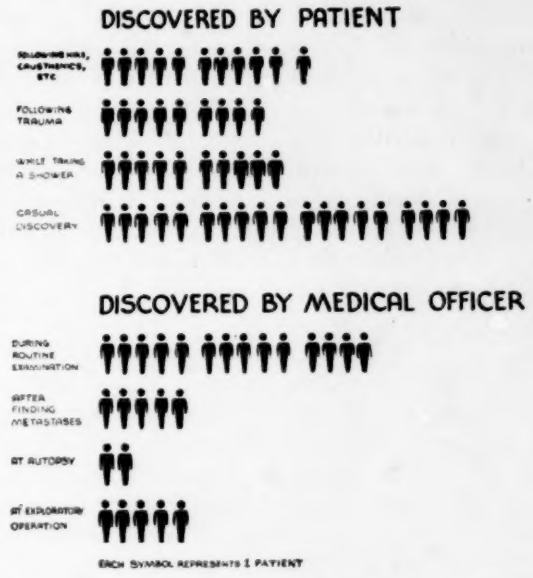

Chart 1.—Chart to illustrate how the testicular tumors were discovered.

TRAUMA

These observations also draw attention to the relationship of trauma to tumor. For only 16 tumors was there a history of either recent or remote trauma, while for 46 no such history could be elicited. Fourteen tumors were found on routine examination by a medical officer, 10 were discovered by the soldier while taking a shower and 11 were noticed after the hard physical effort of outdoor army life caused symptoms such as pain or swelling. Thus in this series 35 of the 62 tumors were present and unknown to the soldier. It would be reasonable, therefore,

From the Urological Section of the Surgical Service, Brooke General Hospital, Fort Sam Houston, Texas.

1. Hinman, F., and Smith, D. R.: Tumors of Testis, J. Med. **22**:393 (Nov.) 1941.

2. Dean, A. L., quoted by Lowsley, O. S., and Kirwin, T. J.: Clinical Urology, Baltimore, Williams & Wilkins Company, 1944.

3. Testicular Tumors, News and Comment, Bull. U. S. Army M. Dept., April 1944, no. 75, p. 34.

to assume that the 9 tumors associated with direct recent trauma must have been present at the time of injury and that the injury, like the shower bath, merely directed the patient's attention to his scrotal mass. Except for that, there is no possible direct etiologic relationship between the trauma and the tumor.

Some authors have expressed the opinion that frequently repeated trauma to an undescended testis accounts for the greater incidence of tumors in undescended than in normally descended testes. However, in 1 of my patients an embryonal carcinoma developed in an intra-abdominal testis; in another, a man of 39, a similar tumor developed in a scrotal testis which had not descended until the age of 10 years, when spontaneous descent occurred, while in a third a malignant teratoma developed in a testis for which an orchidopexy had been successfully done thirteen years previously. The greater frequency of tumors in undescended testes would, therefore, seem to be not so much the result of trauma but associated with some congenital malformation, which in itself may play a part in the lack of normal descent.

This is further emphasized by Hamilton and Gilbert,[4] who pointed out not only the greatly increased incidence of tumors in undescended testes but the still far greater incidence of tumors occurring in abdominal testes, in which the factor of trauma can be entirely excluded.

DIAGNOSIS

The difficulty of diagnosis, which was pointed out so well by Gilbert [5] in 1942, is also illustrated in this series of tumors (chart 2). Of the 62 tumors, 1 was originally diagnosed as a varicocele, 1 as an enlarged testis, 6 as hydroceles and 5 as traumatic orchitis; but the largest number, 14, were incorrectly diagnosed as epididymitis, orchitis or epididymo-orchitis. Either because of the chronicity of the disease or because of lack of fever, pain, redness and other symptoms of an acute lesion, many were qualified as tuberculous. Despite these incorrect initial diagnoses, all of the patients with 1 exception were operated on within four months from the time the lesion was first seen by a medical officer. Forty-two, or 82.3 per cent, of the patients with malignant tumors were operated on before the end of the second month after they first sought medical advice.

4. Hamilton, J. B., and Gilbert, J. B.: Studies in Malignant Tumors of Testis: Bilateral Testicular Cancer, Cancer Research **2**:125 (Feb.) 1942.

5. Gilbert, J. B.: Pitfalls in Diagnosis of Testis Tumors, M. Times, New York **70**:85 (March) 1942.

BENIGN LESIONS

Of the 62 lesions which were clinically diagnosed as testicular tumors, 11 proved to be benign. One of these was an adult teratoma, being a cystic structure and containing cartilage, striped muscle and glandular elements.

CASE 1.—The patient gave a history of an injury twelve years previously, followed by scrotal enlargement, for which an operation for hydrocele was done a year later. Five months before his admission to the hospital, he was again struck on the same testis, with subsequent swelling, for which, three months later, he was admitted to the hospital. At this time, a diagnosis of recurrent hydrocele was made, aspiration attempted and the soldier returned to duty. As a result of persistent increase in the size of the testis, he was again hospitalized two months later. The testis had by now increased to ten times the size of the normal one. The structure felt cystic but could not be seen by transillumination. The spermatic cord was thickened but not nodular. Despite the absence of metastasis and a negative reaction to the Friedman test, orchiectomy

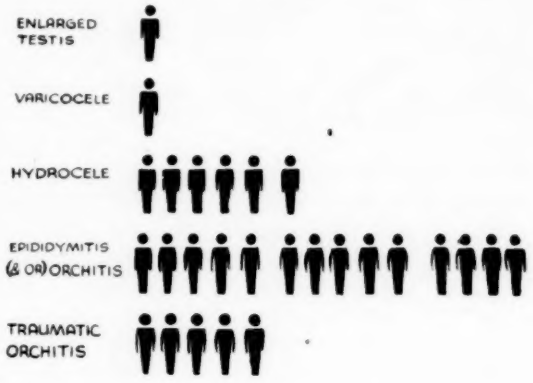

Chart 2.—Chart giving original diagnoses, to illustrate the difficulty in making an accurate diagnosis when the patient first complains of symptoms. Each symbol represents a patient.

was performed in October 1943. A prophylactic course of deep roentgen therapy was given, and the soldier was returned to duty.

A second benign tumor was found on section to be a cavernous hemangioma of the testis.

CASE 2.—A 20 year old soldier gave the following history: In 1938 he had pain in the right testis, followed by swelling for two to three hours. In 1940 he had a similar attack of pain, but this time there was no appreciable change in the size of the testis. On Dec. 8, 1943, he was awakened at 3 a. m. with severe pain, for which he was admitted to the hospital. During the next forty-eight hours he had fever, and the scrotal content increased to the size of a small orange. He was given sulfathiazole, and an ice bag was applied to the scrotum. His condition suggested acute epididymitis. The swelling gradually subsided, and a month later he was discharged to duty. There was no history of injury and no evidence of gonorrhea. After doing duty for two weeks he went on sick call, because his testis was hard and heavy and

"bothered" him. On examination, the right testis was found to be barely twice normal size (as compared with the left), but it seemed to be almost entirely replaced by a hard, smooth, heavy organ. It was not possible to feel the epididymis separate from the testis. No clinical evidence of hydrocele was present. The cord was normal. The patient was admitted to the hospital with a clinical diagnosis of tumor of the testis. This diagnosis was concurred in, and orchiectomy was performed. On section, a cavernous hemangioma was found within the tunica albuginea, which replaced about one third of the testis.

CASE 3.—A 22 year old soldier was admitted to the hospital three months after he discovered, while taking a shower, that his left testis was large. He had had no injury, but owing to the progressive increase in the size of the testis and the onset of pain he eventually sought medical aid. On examination, the left testis was observed to be three to four times the size of the right; it gave a sensation of weight but was smooth and well shaped and felt like a soft hydrocele. However, because it was not translucent and because the epididymis could be felt, a diagnosis of hydrocele could not be made; consequently, exploratory operation for tumor was advised. At operation, the testis was seen to be about four times normal size and extremely soft and mushy, as though the entire testicular substance were necrotic and liquefying. Without opening the tunica albuginea, orchiectomy was performed, and later, on section, the testis was found to have undergone "coagulative necrosis." Another testis which was similarly removed contained a small interstitial cell tumor.

Among the other benign tumors operated on was a dermoid cyst which was found within the tunica albuginea of the testis. None of the benign tumors could be differentiated on clinical findings alone from malignant growths; consequently I feel that it is extremely unwise for a physician to give high voltage roentgen or radium therapy to a patient because he thinks he can by clinical examination alone make a correct diagnosis.

MALIGNANT TUMORS (CLINICALLY OBSCURE)

In 1 of the patients with clinically obscure malignant testicular tumor the primary lesion was not found until autopsy, despite previous careful examination of the scrotal contents.

CASE 4.—The patient was admitted to the hospital with a large "retroperitoneal sarcoma," which grew locally in size and eventually killed the patient without any metastatic spread. He had had epididymitis six months before admission, and during his stay in the hospital the old healed epididymal lesion was recognized, but the testes were normal in size and consistence. At autopsy a malignant teratoma, measuring 1.5 cm. in diameter, was found within the left testis.

CASE 5.—Another patient was admitted to the hospital with pulmonary metastasis, which appeared to be either testicular or renal in origin. Pyelograms were normal, and the testes were thought to be normal when palpated, even with the knowledge that one or the other must contain a malignant growth. On the basis of a history of traumatic orchitis on the right side two months previously, an orchiectomy was performed on that side. On section, a tumor less than 1 cm. in its greatest diameter was found within the testis. Microscopically, this was seen to be a malignant teratoma.

In addition to these patients, 5 others were admitted to the hospital because of the finding of metastasis, which later led to the discovery of the primary testicular lesion.

METASTASIS

In this series, only 15 of 51 malignant tumors showed evidence of metastasis when the patient was first admitted to the hospital, and 2 of these 15 showed no clinical evidence of the primary lesion. This incidence of only 30 per cent of tumors with clinical evidence of metastasis at the time of hospitalization is in sharp contrast to that in Hinman's [6] series of 80 tumors in which 41 showed evidence of metastasis. Unquestionably, several other tumors must have undergone metastasis which was not clinically demonstrable at the time of admission, for in at least 3 patients recognizable metastasis developed while the patients were receiving treatment. This lowered incidence must, in great part, be due to the fact that soldiers have easy access to medical advice and to frequent routine physical examinations.

TREATMENT

After a careful history concerning the nature and development of the scrotal lesion has been obtained, a careful physical examination done and a diagnosis of malignant tumor of the testis arrived at, orchiectomy or, in occasional questionable cases, an exploratory operation should be performed without further delay and without preliminary roentgen or radium therapy. This should be done principally to establish a correct and accurate diagnosis, for in my experience it has not been possible in several instances to establish the correct diagnosis in any other way. Without primary operation several of the patients with benign lesions might have been treated as though they had cancer.

I consider effective and efficient irradiation a serious matter, for it must do a certain amount of permanent injury or damage to normal tissues. Furthermore, orchiectomy should be done as a radical and not as a minor scrotal procedure.

A. *Technic of Radical Orchiectomy.*—The incision extends from the level of the external inguinal ring to above the internal ring. The aponeurosis of the external oblique muscle is split from the external ring upward. The internal oblique muscle is then separated from the cord, and the cord is dissected up to beyond the point where the vas deferens and the vascular

6. Hinman, F., cited by Taylor, G. W., and Nathanson, I. T.: Lymph Node Metastases, New York, Oxford University Press, 1942.

portion of the cord separate. The adherent peritoneum is stripped off the cord, and the cord is ligated and divided as high as possible. The vas deferens is then pulled up, ligated and divided. Only then should the cord be dissected down to the external ring and the testis with all its tunics removed from the scrotum. If the tumor is small, it may be delivered through this incision. If it is large, it is preferable to make a scrotal incision through which to deliver the testis and the cord. This avoids all manipulation except that which is absolutely necessary.

High ligation of the cord is essential for several reasons. First, any early extension up the lymphatics is removed. Secondly, the possibility of a local recurrence is greatly reduced; thirdly, should there be any tumor at the site of the division of the cord, the recurrence will grow as an intra-abdominal mass, which will not distress the patient as would a fungating mass in the wound.

B. *Technic of Scrotal Exploratory Operation.*—In occasional instances in which there is reasonable doubt as to the nature of the testicular tumor, an exploratory operation may be done. This consists of a scrotal incision carried directly down through the tunica vaginalis without any dissection. Through this incision, the testis can be delivered into the wound. If the tumor is found to involve the testis, the previously described radical procedure is carried out. If it proves to be an old thick-walled hydrocele, an organized hematocele, a tumor of the tunica vaginalis or epididymis or some similar lesion, the testis may be preserved. If the surgeon feels it is necessary to open the tunica albuginea either with a scalpel or with a needle for diagnostic purposes, he would be well advised to do an orchiectomy and let the pathologist do any further exploration. Testicular tumors, as a group, are too malignant and spread too easily and rapidly for one to risk disseminating them. Exploratory operations, except in unusual circumstances, are consequently not recommended. It is far preferable to do an orchiectomy for a benign lesion than to disseminate a malignant one by meddlesome surgical intervention.

Whether there is clinical evidence of metastasis or not, the orchiectomy should be followed within a week by a course of high voltage roentgen therapy to the abdominal lymph nodes along the normal course of spread up to and including the periaortic lymph nodes on both sides in the region of the renal vessels.

Radical excision of the abdominal lymph nodes was not carried out on any of my patients.

RESULTS

Of the 51 patients admitted to the hospital with malignant testicular tumors, 11 are dead; 6 are still living with metastasis, while 36, or 72 per cent, are alive without clinical evidence of metastasis. Of these 36, 16 have been alive from a year to twenty-five months following operation. I am inclined to feel that the relatively low incidence of metastasis is due to early diagnosis. Early diagnosis is favored by the routine of army life. Hikes, calisthenics and combat training make a soldier aware of the presence of a tumor. So, too, do regular shower baths, and much credit must be given to the value of careful routine physical examinations.

SUMMARY

A statistical analysis of a series of 62 testicular tumors seen during a two year period in an army hospital indicates that there is a greater incidence of this type of lesion in army personnel than among civilians; however, it is felt that this is due to the easy access which a soldier has to medical advice, to the frequent routine physical examinations and to the fact that a physically fit and active man is especially likely to notice an enlarged, hard or painful testis.

Trauma, except for drawing the soldier's attention to the tumor, bears no etiologic relationship to the lesion.

A testicular tumor when first seen is frequently mistaken for some other lesion. The most common diagnostic error is to consider the tumor as epididymitis, orchitis or hydrocele.

Eleven, or 18 per cent, of the tumors were benign.

Radical orchiectomy, as described in this article, followed by immediate high voltage roentgen therapy resulted in 36, or 72 per cent, of the 51 patients who were admitted to the hospital with malignant testicular tumors being alive without clinical evidence of metastasis. Of these 36, 16 have been alive from one year to twenty-five months following operation.

EARLY REPAIR OF NEURAL WOUNDS WITH PENICILLIN THERAPY

COMMANDER NATHAN C. NORCROSS (M.C.), U.S.N.R.

The longer a damaged nerve is left unrepaired the less is the chance of there being a satisfactory end result. Primary suture is of course desirable, but under wartime conditions it is rarely possible. Even though it has been found that some time, as measured in weeks, or even in a few months, can lapse before the end result is effected in a measurable degree, it seems desirable to keep the time element to a minimum; this has been done during the past two and one-half years.[1] The decision whether surgical intervention is necessary during this early period is difficult to make, and a thorough knowledge of the physiology of the nerve and of the clinical manifestations of disordered function is of paramount importance. Various features of this problem will be dealt with in later communications, but briefly they are those set down by Tinel years ago.[2]

Recently, in a large base hospital, it has been possible to treat patients with neural wounds within a few days after the injury. Because some of the patients complained of severe pain, it was decided to give them penicillin therapy and to operate on them shortly after their admission to the hospital, in spite of infection.

Two groups of patients have been treated in this way: men whose wounds were healing by primary intention without infection and men whose wounds were still open and showed varying degrees of infection. For no patient with acute inflammation of the wound was this treatment attempted. To patients with apparently clean wounds, penicillin was given for two days before operation and for six to eight days afterward in doses of 10,000 units intramuscularly every three hours. To the other group (patients with infected wounds) penicillin was given for four days before and for ten or more days after operation in doses of 20,000 units every three hours. These dosages have been found satisfactory, although they have been varied from time to time in individual cases. Local instillation of penicillin solution was used in 2 cases, while in most of the others the wound was dusted with sulfanilamide before closure.

REPORT OF CASES

CASE 1.—D. C. W. was struck by a fragment of a bullet in the upper portion of the right arm. After this his fingers stiffened and became numb. He was evacuated to an aid station, where the fragment of lead was removed from under the skin posterior to the wound through a surgical incision, and both wounds were dressed without suturing. During the evening of the day on which he was injured he started to have severe pain in the hand, which continued. This pain was deep and not well localized and was aggravated by noise or by movement. Examination on his admission to the hospital, two days after the injury, showed two longitudinal lacerations on the medial aspect of the right arm, both about 2½ inches (6 cm.) long. Their edges were well approximated and dry. There was partial motor paralysis of the right median nerve, and superficial sensation in the distribution of this nerve was lost. Deep pain sense was retained. There was marked tenderness over the course of the nerve from the level of the wound to the wrist. Administration of penicillin was started on the day after hospitalization, and four days later, seven days after the injury, because of continued severe pain, operation was undertaken. The edges of the original wound were trimmed back to healthy tissue; the median nerve was exposed and found to be cut two thirds of the way through. This area was resected, with sacrifice of about ½ inch (13 mm.) of the nerve. When this was done, degenerated tissue, myelin, etc., came out of the cut ends, both proximal and distal, like tooth paste. This degeneration allowed the sheath to collapse and made approximation rather difficult. An end to end anastomosis was carried out with interrupted sutures of fine silk, and the wound was closed in layers with interrupted sutures of fine stainless steel wire. Several similar sutures were placed in the skin of the other incision. The elbow was bent to 90 degrees, to relieve tension on the anastomosis, and a plaster splint was applied. Administration of penicillin was continued until the second postoperative day, when it had to be stopped because of a febrile reaction.[3] Sulfadiazine was then given in its place for six days. The wound healed by first

This is the second of a series of communications on injuries of the peripheral nerves.

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1. Norcross, N. C.: Operative Experiences on Wounds of Peripheral Nerves from the Pacific Combat Area, Bull. Am. Coll. Surgeons **28**:127 (June) 1943.

2. Tinel, J.: Nerve Wounds, London, Baillière, Tindall & Cox, 1917.

3. During this period there were several febrile reactions to the penicillin, which were believed to be due to impurities in the preparation used.

intention. Three weeks after the operation the elbow was partially extended and was further extended slightly every few days for two and one-half weeks. Five and one-half weeks after the operation the arm was straight, and Tinel's sign had progressed to a point 2 inches (5 cm.) below the site of the suture. The neuritic pain was considerably lessened but not relieved entirely.

Because of the difficulty in suturing the nerve sheath during the active stage of wallerian degeneration, it was decided not to operate so early again. However, I can see no other reason to contraindicate early operation, and the rapid advance of Tinel's sign is intriguing.

CASE 2.—R. V. was admitted to the hospital eight days after he had been wounded, having been hit by a metal fragment in the back of the right thigh. His leg quivered and buckled under him, and he had severe pain running down to the foot. Four days after the injury an unsuccessful attempt was made to remove the fragment. Examination showed a 4 inch (10 cm.) wound in the posterior part of the right thigh, which was packed with petrolatum gauze. When this gauze was removed, a considerable amount of watery pus escaped. He had almost complete paralysis of the sciatic nerve below the level of the lesion and complete drop foot. He had had neuritic pain constantly since the injury. Administration of penicillin was started and continued for four days, by which time there was almost no drainage. The pain was, if anything, worse, and operation was therefore considered advisable. Twelve days after the injury he was operated on. The edges of the wound were trimmed back to healthy tissue, and a small portion of muscle badly contused was excised. The sciatic nerve was exposed and observed to be surrounded and constricted by scar but not otherwise damaged. The metal fragment was not easily accessible and was not removed. The wound was thoroughly irrigated, penicillin solution instilled and the wound closed without drainage in layers with interrupted sutures of stainless steel wire. Penicillin was administered for six days, at which time its use was discontinued because of a febrile reaction.[3] The wound healed by first intention, without any further evidence of infection. Some return of function was noted on the first postoperative day, and improvement continued steadily until the patient's transfer, six weeks after the operation. The neuritic pain was considerably improved but was not eliminated.

COMMENT

Ten additional patients have been treated in a like manner from twelve days to four weeks after the original injury; 3 had anastomoses and 7 neurolyses. All wounds healed by first intention, without complications. In 1 case, in which the ulnar nerve was sutured through a granulating, but apparently clean, wound, no penicillin was given because of misunderstanding of orders in the ward, but in this case, too, healing occurred without complication.

These early operations were originally undertaken in an attempt to relieve the pain and minimize the trophic changes which may occur with early severe neuritic disturbances. It is too soon to judge whether or not this goal has been attained, although the early results are promising. They do demonstrate, however, that with prophylactic or suppressive penicillin therapy definitive surgical treatment can be carried out for neural wounds much earlier than has heretofore been deemed advisable.

CONVULSIVE FACTOR IN COMMERCIAL PENICILLIN

A. EARL WALKER, M.D.,* AND HERBERT C. JOHNSON, M.D.
WITH THE TECHNICAL ASSISTANCE OF WILLIAM H. FUNDERBURK, B.S.
CHICAGO

Reports on intrathecal administration of penicillin in treating infections of the central nervous system are becoming numerous. Recently intraventricular injection of penicillin has been employed when meningitis did not respond to parenteral or intrathecal modes of administration.[1] The direct application of penicillin to wounds of the cerebral cortex in the treatment of injury to the head has also been suggested.[2] Our interest in the effect of penicillin on the central nervous system was aroused by observing convulsive seizures following intraventricular injection of the drug in a case of ventriculitis.[3] Experiments were then planned to investigate the effect of the drug when administered intracisternally, intraventricularly and locally to the cerebral cortex either by application to the subdural space or by intracortical injection. Such experiments were performed, and it was observed that certain doses of penicillin so administered to mice, cats, dogs and monkeys gave rise to convulsive manifestations. This report deals particularly with the effect of commercial penicillin on the cerebral cortex.

METHODS AND MATERIALS

Some 11 monkeys and 19 cats were used repeatedly in this study. All operative procedures for chronic experiments were carried out aseptically with the animal under general anesthesia induced with pentobarbital sodium administered intraperitoneally.[4] For acute experiments the animals were usually prepared under anesthesia induced by vinethene and procaine hydrochloride. For routine electroencephalographic studies curare was given to insure that muscular movements should not introduce artefacts. Respiration was then maintained artificially. The electrodes used for obtaining the electroencephalograms were screwed into the calvaria and insulated from skin and muscle. The electrocardiogram was derived from needle electrodes inserted in the muscles of the two forelimbs. The amplifiers used for augmenting the electrocardiogram and the electroencephalogram were two-sided resistance-capacity-coupled machines with direct coupling between the last two stages, working into an ink-writing oscillograph.[5]

Commercial penicillin,[6] made by seven different manufacturers in the form of sodium penicillin, was used; all specimens gave similar results. Routinely the penicillin was dissolved in sterile isotonic solution of sodium chloride, but other solvents have been used without greatly modifying the convulsive factor. In the acute experiments the penicillin solution, usually 0.05 cc., was injected into the subdural space through a trephine hole. In the chronic experiments a hypodermic needle was inserted through the skin and a trephine hole into the cerebral cortex. The absolute site of these injections could not be accurately gaged because of the varying thickness of the animals' scalps and skulls, but an attempt was made to inject the penicillin solution, usually 0.05 cc., just beneath the dura mater.

An estimate of the antibacterial potency of the penicillin inactivated by various methods was made by the agar hole method suggested by Fleming.[7]

EFFECTS OF INTRACORTICAL INJECTION OF PENICILLIN

Both the cat and the monkey within five minutes of injection of 0.05 cc. of a solution containing 1,000 or more Oxford units of penicillin appeared listless and became uninterested in their surroundings. The cat frequently cried as if in distress. At times the animal exhibited evidences of sympathetic discharge, the pupils dilating, the back arching and the hair, particularly that of the tail, standing erect. Saliva sometimes drooled from the mouth. At about the same time the animal began to have quick myoclonic jerkings of the extremities or face

Presented as a demonstration to the Central Neuropsychiatric Association, Oct. 30, 1944.

* From the Division of Neurological Surgery and the Otho S. A. Sprague Memorial Institute, the University of Chicago.

1. McCune, W. S., and Evans, J. M.: Intraventricular Penicillin in the Treatment of Staphylococcic Meningitis, J. A. M. A. **125**:705-706 (July 8) 1944.

2. A Review of the Florey and Cairns Report on the Use of Penicillin in War Wounds, J. Neurosurg. **1**:201-210, 1944.

3. Johnson, H. C., and Walker, A. E.: Intraventricular Penicillin: A Note of Warning, J. A. M. A. **127**:217-219 (Jan. 27) 1945.

4. Dr. Jerry J. Kollros rendered technical assistance in the preparation of the animals.

5. Dr. Theodore J. Case gave assistance with the electronic equipment.

6. The penicillin was provided by the Office of Scientific Research and Development from supplies assigned by the Committee on Medical Research for experimental investigations recommended by the Committee on Chemotherapeutics and Other Agents of the National Research Council.

7. Fleming, A.: In-Vitro Tests of Penicillin Potency, Lancet **1**:732-733, 1942.

opposite to the site of injection. At first such jerks occurred every minute or two, but gradually they tended to become more frequent. The jerk was usually a flexion movement of the extremity but might be associated with abduction of a limb or rotation of the head. Whether the upper or the lower extremity was affected depended on the site of the injection into the cerebral cortex; an injection in the motor arm area of the cerebral cortex produced an attack that involved primarily the contralateral foreleg, and an injection in the motor leg area the contralateral hindleg. If the injection was made in the temporal region, twitching of the contralateral ear was the first evidence of the attack. If the injection was made in the prefrontal region the head and eyes turned to the opposite side, and the animal tended to exhibit circus movements.

After these manifestations had been present for ten or fifteen minutes the myoclonic twitchings became a series of jerks of increasing intensity, spreading at the same time to involve the remainder of the musculature on the side contralateral to the injection. With these attacks the animal might be thrown on its side. The animal appeared definitely ill even between the attacks and took little interest in its surroundings. These series of twitchings might last from a few seconds to a few minutes, and then they gradually or suddenly decreased. Such attacks after continuing for a minute or two might become generalized. The seizure then consisted of a long series of clonic movements of the forelegs and hindlegs, the jerking usually being more severe and more persistent in the extremities contralateral to the site of application of penicillin.

At the cessation of the attacks the animal might remain in a dazed or semicomatose state for several minutes. Then another attack started, first in the contralateral extremities but rapidly spreading to the entire body. Such convulsive seizures might continue for several hours. In fact, we have followed such epileptic states for as long as seven hours. Under these circumstances the animal rarely regained consciousness between the attacks but remained in a semicomatose state. The generalized attacks could ordinarily be controlled by intraperitoneal injection of 0.06 to 0.12 Gm. of phenobarbital sodium.

Convulsive Threshold.—In the cat intracortical injections of 10,000 to 20,000 units of penicillin regularly brought on generalized convulsive seizures. Smaller doses usually induced only contralateral twitchings of the extremities. In the monkey, however, the convulsive threshold appeared to be definitely lower. In order to determine more accurately the convulsive threshold a series of 10 monkeys was prepared. The animals were operated on under aseptic conditions, burr holes being placed over the motor cortex on both sides and in the frontal region on both sides. After the animal had recovered from the operation, commercial penicillin was dissolved so that the desired amount could be injected into the cerebral cortex of each animal in 0.05 cc. of isotonic solution of sodium chloride. In the first group of experiments each animal received 2,500 units of penicillin. In 8 of the 10 monkeys generalized convulsive attacks developed within a few minutes. One had localized twitching of the opposite extremities but never had generalized convulsive seizures. On other occasions the animals received injections of 1,000 Oxford units, 500 Oxford units and 250 Oxford units of penicillin at intervals of at least forty-eight hours. All injections were made through the same burr hole into the motor cortex. Seven of the monkeys receiving 1,000 Oxford units had some form of convulsive seizure, 3 of them generalized attacks. Six of those receiving 500 units had twitchings of the opposite extremities, whereas only 1 receiving 250 units had such twitchings (fig. 1). It therefore seems that for most monkeys the local application of penicillin in doses of more than 500 Oxford units produces convulsive manifestations. The convulsive threshold has not been determined for the cat, but from preliminary observations it seems likely that it will be somewhat higher than for the monkey.

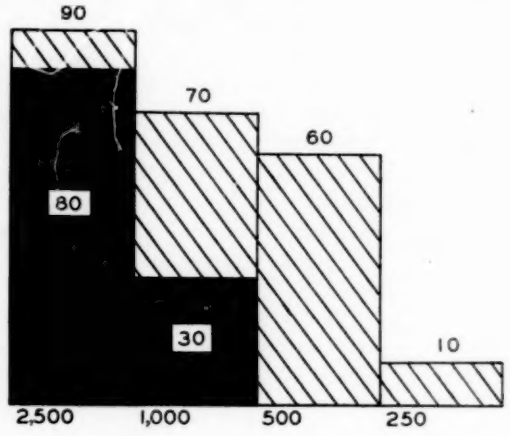

Fig. 1.—Histogram showing the percentage of monkeys in which convulsive manifestations developed after the intracortical injection of 2,500, 1,000, 500 and 250 Oxford units of penicillin dissolved in 0.05 cc. of isotonic solution of sodium chloride. The solid black represents generalized convulsive seizures; the lined portions, unilateral or focal seizures.

Electroencephalographic Manifestations.—If a cat or a monkey receives an injection of a solution of penicillin or if dry penicillin is placed on the arachnoid over the cerebral cortex while an electroencephalogram is being made, within five to ten minutes after the application spikes begin to appear in the leads about the area of application. These spikes are either uniphasic or biphasic and initially are present only in the leads from the area to which the penicillin has been applied. Within two or three minutes similar spikes are seen in leads taken from other portions of the cerebral cortex. These spikes occur every few seconds, and if the animal has not been curarized the spikes are usually accompanied by twitchings of one or both of the contralateral extremities. The spikes continue to occur at frequent intervals, gradually becoming closer together. After a series of spikes there is usually a period of decreased cortical activity. This series of spikes is the electroencephalographic manifestation of the myoclonic jerkings of the extremities (local fit) (fig. 2). Usually they are seen within fifteen minutes after application of a convulsive dose of penicillin to the cerebral cortex. In twenty to thirty minutes after the application of penicillin the spikes become practically continuous in all leads for as long as five or six minutes. Such bursts are accompanied clinically by a generalized convulsive seizure.

The convulsion may stop suddenly, or its termination may be heralded by spikes occurring every two or three seconds. Electrical activity of the brain at the end of the seizure is almost abolished, the cortex appearing practically isoelectric. Within a minute small humps or rounded spikes begin to appear more prominently in the leads from the site of application of the penicillin. These spikes increase in frequency until the convulsive electroencephalographic pattern is fully developed again and the animal goes into another generalized convulsive seizure. This may take from three to four minutes, when the animal has a generalized convulsive seizure lasting three or four minutes. Then the entire sequence begins again. This electroencephalographic pattern has been followed for more than twelve hours (figs. 3 and 4).

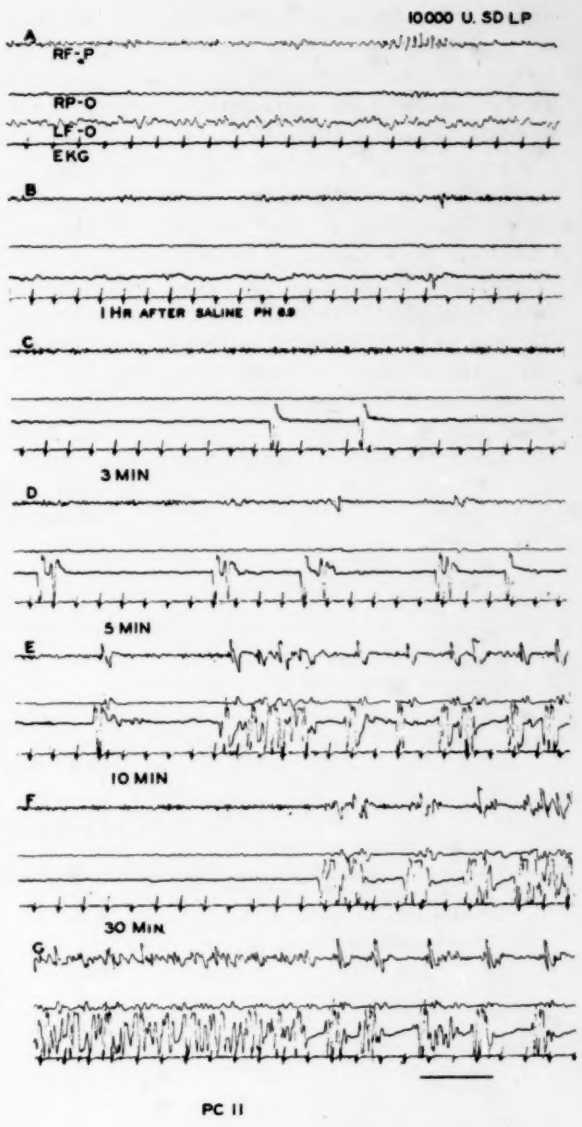

Fig. 2.—Electroencephalogram of a cat, which was prepared under vinethene and procaine hydrochloride anesthesia, curarized and artificially aerated, showing the effect of a subdural injection of 10,000 Oxford units of penicillin into the left parietal region. The leads were as follows: RF-P, right frontoparietal; RP-O, right parieto-occipital, and LF-O, left fronto-occipital; E.K.G., the two forelimbs. *A*, control record. *B*, one hour after subdural injection of 0.2 cc. of isotonic solution of sodium chloride adjusted to the p_H of the penicillin solution. *C*, three minutes after subdural injection of 0.2 cc. of isotonic solution of sodium chloride at p_H 7.3 containing 10,000 Oxford units of penicillin into the left parietal region. Spikes are present in the leads on the left side only. *D*, five minutes after the injection. The spikes are more frequent and beginning to appear on the right side. *E*, ten minutes after the injection. The spikes are present in all leads and occur in bursts of three to six. *F* and *G*, continuous record showing a short epileptic burst of activity. The line at the base of the records indicates an interval of one second.

FACTORS POSSIBLY INFLUENCING THE CONVULSIVE ACTIVITY OF PENICILLIN

Irritation as a Nonspecific Reaction to Injection.—That the convulsive effect might be due to a nonspecific reaction caused by injection of an irritating substance into the brain has been carefully investigated. In many cases 0.05 cc.

of isotonic solution of sodium chloride has been injected into the cerebral cortex without deleterious effect. Even 0.05 cc. of 95 per cent alcohol caused no convulsive reaction when injected intracortically.

Concentration of the Drug.—The influence of concentration of the drug on the convulsive effects has been studied in several animals. Obviously wide ranges of concentration are impracticable, because of the small size of an animal's head. Within the concentrations used, 200,000 to 5,000 Oxford units per cubic centimeter, the amount of injected penicillin appears to be more important than its concentration in solution. If an initial dose of the drug does not cause convulsive manifestations, a subsequent larger injection of the same solution may produce fits. Moreover, highly concentrated injections in low doses have failed to induce epileptic phenomena in an animal which a day or two later promptly had seizures when larger doses of a less concentrated solution were injected intracerebrally.

Hydrogen Ion Concentration of the Penicillin Solution.—The possibility that the convulsive phenomena might be the result of the acidity or alkalinity of the solutions employed was readily tested. The p_H of the solution of sodium penicillin employed was found to be 6.88. It was brought to a p_H of 7.3 by the addition of sodium hydroxide. Another solution of sodium chloride was made up with a p_H of 6.88, and 0.1 cc. of this solution was injected into the cerebral cortex of a cat which had been prepared for electroencephalographic study. The electroencephalogram showed no changes within the next hour. Then 0.1 cc. of the isotonic solution containing 5,000 units of penicillin was injected into the cerebral cortex. Within three minutes spikes began to appear and within ten minutes electrical phenomena characteristic of generalized seizures appeared. It seems, therefore, that the hydrogen ion concentration of the penicillin solution was not the factor responsible for the convulsive manifestations (fig. 2).

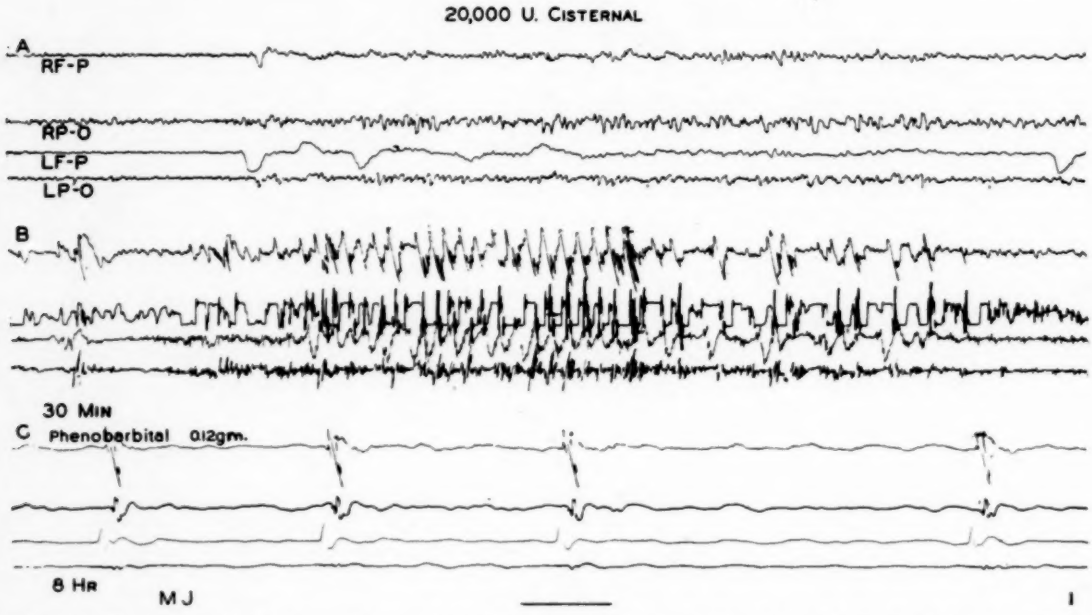

Fig. 3.—Electroencephalograms of a monkey (J), before (*A*) and after (*B* and *C*) the injection of 20,000 Oxford units of penicillin in 0.2 cc. of saline solution into the cisterna magna. Convulsive attacks occurred every two to five minutes for seven hours, being arrested by the intraperitoneal injection of 0.12 Gm. of phenobarbital sodium, although spikes still appeared in the electroencephalogram (*C*). The leads were as follows: RF-P, right frontoparietal; RP-O, right parieto-occipital; LF-P, left frontoparietal; LP-O, parieto-occipital. The horizontal line at the base indicates an interval of one second; the vertical line at the base to the right, a calibration of 60 microvolts.

Antibacterial Potency of the Penicillin Solution.—The possibility that the convulsant factor in commercial penicillin might be due to impurities and not associated with the antibiotic factor has been given serious consideration. Since we were unable to obtain pure crystalline penicillin, the problem resolved itself into an attempt to inactivate selectively one of the factors. Because more was known about inactivation of the antibacterial than of the convulsive factor, methods said to decrease the antibiotic potency were tested. Boiling the penicillin solution for thirty minutes, aging the solution for

seventeen days, dissolving it in dehydrated alcohol and finally treating the penicillin solution with concentrated hydrochloric acid and then neutralizing it with sodium hydroxide were all tried.

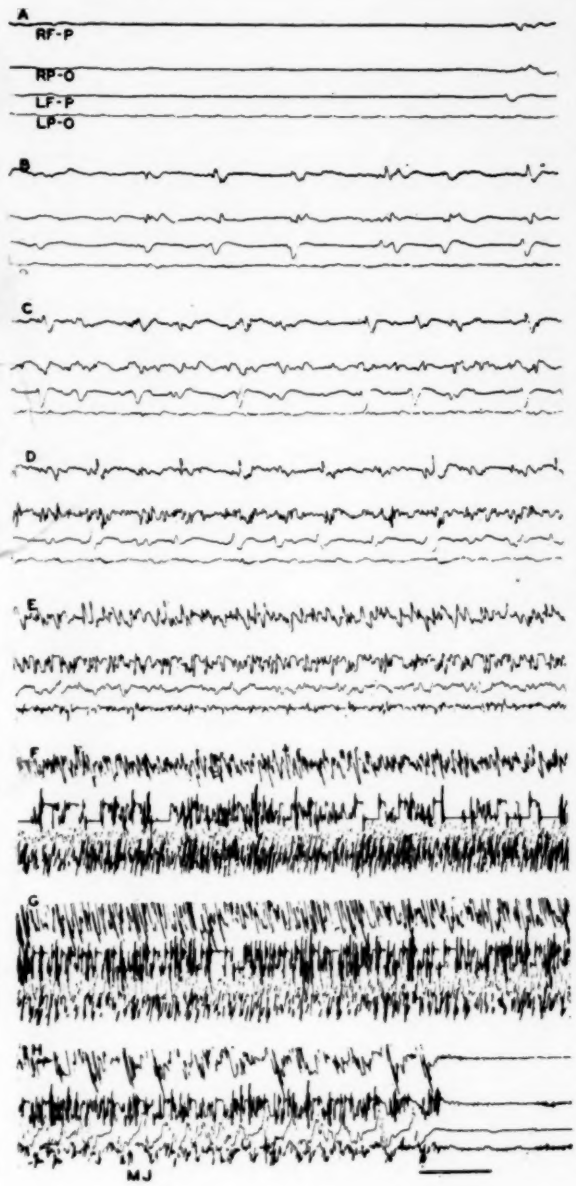

Fig. 4.—A series of electroencephalograms taken at one minute intervals from a monkey (J) approximately three hours after the injection of 20,000 Oxford units of penicillin into the cisterna magna. The leads are the same as in figure 3. The gradual development of the generalized fit is well demonstrated as well as the abrupt cessation of the seizure. Such convulsive manifestations recurred every two to five minutes and lasted five to eight minutes.

These methods decreased both the antibiotic and the convulsive effects about equally. Autoclaving the powder has not given consistent results, but in experiment it practically abolished the antibiotic factor but only slightly lowered the potency of the convulsive factor. This result indicates that the two effects may be separated but does not conclusively prove that the convulsive factor is not related to the antibiotic factor. When pure crystalline penicillin is available the question may be answered more conclusively.

Species Susceptibility.—The convulsive effect of penicillin on the central nervous system is dependent not only on the dose of the drug but also on the species of the experimental animals. As little as 20 Oxford units administered intracerebrally to mice may cause seizures, and ten times that amount may cause a fatal status epilepticus. For cats the threshold is probably about 1,000 to 2,000 Oxford units, and for monkeys, less than one half of that. Fortunately a considerably larger dose of penicillin may be injected intracerebrally or intraventricularly into human beings without producing convulsive manifestations. We have injected 5,000 Oxford units into the occipital cortex without causing clinical or electroencephalographic abnormalities. An injection of 20,000 Oxford units into the occipital cortex produced electroencephalographic changes but no clinical concomitant signs. Injected near the motor area, however, 10,000 Oxford units has given rise to twitchings of the face and hands for three hours. Since the full therapeutic effect of penicillin may be obtained with doses of 20,000 units or less, it seems improbable that the clinical advantages of this drug will be marred by its convulsive factor. This is particularly likely to be true since in practice the drug is injected not into normal cerebral cortex but into wounds or abscess cavities, the inflammatory linings of which impair diffusion of the penicillin to the adjoining nerve tissue. However, the amount of penicillin injected into the cisterna magna and the cerebral ventricles may well be limited by the convulsive factor.

SUMMARY

The application of commercial penicillin to the cerebral cortex of cats, dogs, monkeys and human beings has given rise to convulsive manifestations. The antibiotic and convulsive factors of penicillin appear to be closely related, for they are affected about equally by aging, boiling and acidifying the penicillin solution and by dissolving the penicillin in alcohol. In human beings penicillin applied to the cerebral cortex in doses of 10,000 to 20,000 Oxford units may produce convulsive manifestations.

MÉNIÈRE'S DISEASE IN A DEAF-MUTE

WALTER E. DANDY, M.D.

BALTIMORE

This report describes typical attacks of Ménière's disease during early life in a man who was congenitally deaf and dumb. It also contributes evidence concerning the underlying pathologic features of mutism.

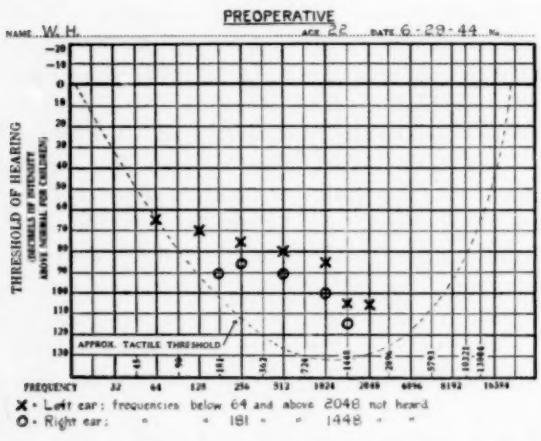

Fig. 1.—Audiogram of the patient (deaf-mute) taken before operation. The hearing for sounds interpreted only as noise is less on the affected side.

REPORT OF A CASE

W. H., a deaf-mute man aged 22, complained of dizzy spells, associated with nausea and vomiting.

History.—So far as is known, the patient had never heard or spoken. He had scarlet fever at the age of 2 years but had no infection of the middle ear then or subsequently. His conversation was carried on through sign language; he heard nothing. He was bright and worked his way through high school and two years of junior college; during the latter period he played football.

Three months previous to the time of writing, attacks of rotary vertigo began and occurred with subsequent frequency. Every three or four weeks a severe attack ensued; during these, he became nauseated and frequently vomited; objects whirled. The attacks were heralded by a noise in the right ear (although he had no hearing). During the last attack he was bedfast for several days. During the attacks there was a sense of fulness about the right ear.

A test with the audiometer was interesting, in that certain wave frequencies were consistently registered as "noises," and the range of sounds was less on the affected side (fig. 1). That these were actual sound waves, though not appreciated as sound, was shown by the fact that after total division of the right eighth nerve all sounds were lost on that side (fig. 2). There was then no appreciation of any wave frequency. Bárány tests of vestibular function were not made because the Ménière attacks indicated the presence of vestibular function. The absence of disturbed equilibrium following section of the nerve demonstrated the presence of this function on the opposite side.

Operation (June 29, 1944).—Total section of the right eighth nerve was done. After evacuation of the cisterna magna, there was ample room, but because of a rounded hillock of bone overlying the auditory nerve (fig. 3), the cisterna sulci lateralis and the auditory nerve could not be reached safely. This malformation has not been encountered heretofore in a series of 640 cases. To gain access to the cerebellopontile angle it was necessary to remove the outer cap of the cerebellum. This was never necessary in a series of previous cases and clearly demonstrated a congenital abnormality in this region. The cisterna sulci lateralis was then easily reached and opened and the auditory nerve exposed. There was no porus acusticus of the usual anatomic type; the nerve passed into the petrous bone directly and entirely filled the opening, which was

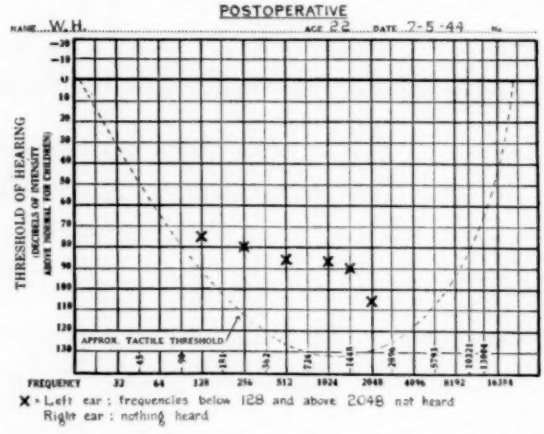

Fig. 2.—Audiogram of the same patient taken after operation. It shows complete loss of sounds interpreted as noise in the right ear following section of the right auditory nerve.

flush with the bone and dura, i. e., there was no excess bony opening about the nerve such as normally obtains at the acoustic foramen. Moreover, the nerve was much deeper than usual and was about 1.5 cm. mesial to the bony hillock, which probably represented a greatly hypertrophied outer lip, which usually overlies

the porus acusticus laterally. The eighth nerve was extremely small; I have never seen a smaller one. The seventh nerve, which is nearly always concealed beneath the auditory nerve, was in full view immediately anterior to it (fig. 3) and passed into the petrous bone with it in a normal relationship. The auditory nerve was then totally divided with the electrocautery. Because of its great depth, a piece of the nerve could not be removed for microscopic study.

The patient made an uneventful recovery and left the hospital eight days later. At the time of this writing, six months later, he had had no attacks and was working full time.

COMMENT

I know of no other reported case of Ménière's disease associated with congenital deaf-mutism. This rarity may be seeming or real. Ménière's disease is not too well recognized, but in two great centers for teaching the deaf and dumb—the great Goldstein school in St. Louis and the school in Cleveland headed by Dr. Kinney—I have made inquiry and have been advised that a case of this disease has never been observed in either of these centers. Its existence would undoubtedly be recognized in these institutes, for both have been controlled by highly competent otologists. There is therefore no reason to believe that Ménière's disease is more frequent among deaf-mutes than in the general population and therefore that the inherited deafness is contributory to the development of this disease. Little is known concerning the underlying pathologic condition of deafness and dumbness. An excellent contribution by Fraser (1931) [1] clearly demonstrates aplasia of the entire labyrinth with malformations of the labyrinth and the organ of Corti. Fraser's photographs of the end organs leave no doubt concerning the great defects of the end organs and therefore concerning the cause of deaf-mutism. He did not demonstrate or consider, and perhaps rightly so, a primary defect in the auditory nerve.

It has been my belief that Ménière's disease is always due to a lesion, congenital or acquired, in the auditory nerve itself and not in one of the end organs.[2] If Ménière's disease is not more common in deaf-mutes than in the general population, Fraser's demonstration of a primary congenital defect of the end organ would be in consonance with the view that a defect in the end organ does not lend itself to subsequent development of Ménière's disease. It is possible that there may be a second and a rare cause of this syndrome, i. e. a primary congenital neural defect of which there was evidence in the case here reported. This may or may not be in addition to a congenital defect in the labyrinth. It is difficult to believe that the findings in this case were more than an unusual coincidence; i. e. probably the primary cause of the mutism

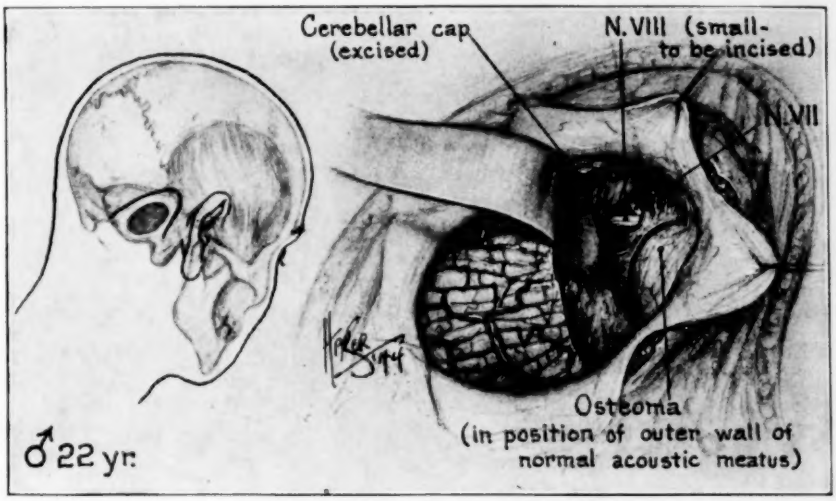

Fig. 3.—Operative sketch showing congenital malformations in the patient: (1) the large hillock of bone which corresponds in position with the outer lip of the normal acoustic foramen and which necessitated resection of the cerebellar cap in order to expose the eighth nerve; (2) the deeply placed eighth nerve, which entered the bone directly and not through a concavity, such as obtains with a normal porus acusticus; it was well below the hillock of bone; (3) an extremely small auditory nerve; (4) the exposed seventh nerve which is normally obscured by the auditory nerve.

1. Fraser, J. S.: The Pathology of Deaf-Mutism, Proc. Roy. Soc. Med. **25**:861, 1932.

2. Dandy, W. E.: Certain Functions of the Roots and Ganglia of the Cranial Sensory Nerves, Arch. Neurol. & Psychiat. **27**:22 (Jan.) 1932.

was in the labyrinth and not the defective auditory nerve. Should the incidence of Ménière's disease in deaf and dumb persons later be shown to be higher than that in the general population, a second type of mutism might then be considered, i. e. one due to a primary defect.

The old French theory that mutism was due to a primary cerebral malformation is no longer tenable, at least in more than a small percentage of cases. Goldstein [3] has demonstrated unequivocally that the lesion is peripheral, because, with few exceptions, speech can be developed in a deaf-mute if treatment is instituted early; this has been substantiated by others. Goldstein [4] and Kinney [5] have demonstrated that in most cases there are "islands of sound perception" which, however, are beyond the limits of practical utilization. These and total loss of sound after section of the auditory nerve are well illustrated in the case here reported.

3. Goldstein, M. A.: The Acoustic Method for the Training of the Deaf and Hard-of-Hearing Child, St. Louis, Laryngoscope Press, 1939.

4. Goldstein, M. A.: Problems of the Deaf, St. Louis, Laryngoscope Press, 1933.

5. Kinney, C. E.: Interpretation of Hearing Tests, Laryngoscope **53**:223, 1943.

SYNDROME OF TRAUMA TO THE PSOAS MUSCLE

MAJOR ELLIOTT MICHELSON
MEDICAL CORPS, ARMY OF THE UNITED STATES

The psoas muscle is a long, powerful muscle which, in spite of its virtual continuous activity when a person is sitting and walking, is never subject to direct violence and is rarely indirectly traumatized. Strandell [1] recently reviewed the literature and cited 13 cases of subcutaneous rupture of the iliopsoas muscle, in 8 of which the rupture occurred in a normal muscle. Haldeman and Soto-Hall [2] reported 2 cases of trauma to the psoas muscle in a series of 104 injuries to muscles and tendons. Trauma to the psoas muscle may produce fibrillar, partial or complete rupture of the muscle bundles. The clinical picture depends on the degree of rupture, the site and size of the secondary hemorrhage, the irritation of contiguous nerves and structures and such complications as formation of a cyst, calcification and infection. Strandell has shown that a definite diagnostic picture is obtained, consisting of sudden acute pain, which is often accompanied by a knocking sound, followed by a latent asymptomatic period, with pain and disability returning within an hour to several days. A case of trauma to the psoas muscle is here reported, because it too reveals this interesting clinical syndrome. A hitherto unmentioned diagnostic sign, deviation of the lower pole of the kidney and the upper third of the ureter by the mass in the psoas muscle, is described.

Knowledge of the anatomy of the region containing the psoas muscle is invaluable in understanding this clinical entity. The psoas muscle takes its origin from the lateral border of the vertebral bodies of the twelfth dorsal and the upper four lumbar vertebrae together with the intervening disks and the transverse processes of the lumbar vertebrae. The muscle unites with the broad iliac muscle, which takes its origin from the inner aspect of the ilium, and together they slide beneath the inguinal ligament as a tendon to insert into the lesser trochanter. The muscle flexes, adducts and externally rotates the femur, and if the femur is fixed the spine and pelvis are flexed. The muscle is covered by a broad, firm fascial sheath, which is attached mesially to the anterolateral border of the lumbar vertebrae and laterally to the anterior layer of the lumbodorsal fascia. Superiorly the fascia opens directly into the posterior mediastinum, and inferiorly it gives rise to a bursa, which is situated on the anterior aspect of the hip joint and may communicate with the joint proper. The sheath is covered by areolar tissue, which serves as a bed for the kidney, ureter, ascending colon, duodenum and root of the mesentery on the right and the kidney, ureter and descending colon on the left. The blood supply of the psoas muscle comes from the iliolumbar branch of the hypogastric artery, the deep circumflex iliac branch of the external iliac artery and the lumbar branches of the aorta. There are numerous small lymph glands in the vertebral insertions of the psoas muscle fibers, and a large chain of lymph channels, which drain the lower extremities and the pelvis, lies above the sheath of the psoas muscle. The twelfth dorsal nerve emerges through the diaphragm and passes behind the psoas muscle. The iliohypogastric nerve runs through the psoas muscle just below the renal vessels; the ilioinguinal and lateral femoral cutaneous nerves travel beneath the psoas muscle, and the genitofemoral nerve runs first through the psoas muscle at the level of the second lumbar vertebra and then along its anterior sheath. The femoral nerve lies inside the muscle from its origin in the plexus down through the lacuna musculorum.

In view of the intimate association between the lymph glands and the vessels draining the pelvis and the lower extremities, it is easily understood how infection of the lower extremities might drain into the lymph chain of the psoas muscle, with suppurative adenitis and formation of an abscess within the psoas muscle. Infection along the root of the mesentery, perforation of the bowel, diverticulitis or appendicitis by agglutination with the anterior sheath of the psoas muscle may also produce abscesses of the psoas muscle. Tuberculosis of the dorsal and, in rare

1. Strandell, G.: Subcutaneous Rupture of the Iliopsoas Muscle, Acta chir. Scandinav. **86**:149, 1942.

2. Haldeman, K. O., and Soto-Hall, R.: Injuries to Muscles and Tendons, J. A. M. A. **104**:2319 (June 29) 1935.

instances,[3] of the cervical vertebrae may dissect down through the posterior portion of the mediastinum and enter directly into the psoas muscle. Inflammation of the psoas muscle produces contracture with flexion, adduction and external rotation of the femur. By pulling on the intervertebral disks and the transverse processes on that side scoliosis is produced, with evident concavity toward the affected side. In view of the fact that the psoas muscle lies in an oblique position to the vertebrae, any expansion of the muscle from infection or tumor will push structures lying above it lateralward into the lumbar fossa. Retrograde pyelograms therefore should and do reveal displacement of the lower pole of the kidney and the upper third of the ureter when a mass in the psoas muscle is present. Sudden increase in pressure within the psoas sheath due to hemorrhage and/or infection may irritate the enveloped nerves sufficiently to produce symptoms of neuritis. Nerves are not involved with chronic slowly progressive lesions, such as arthritis of the spine due to tuberculosis. Acute and chronic masses of the psoas muscle may present in the flank, the abdomen, the pelvis or the infrainguinal position. Pus within the sheath dulls or obliterates the outline of the psoas muscle on the roentgenogram. In hemorrhage, with an intact psoas sheath, the outline of the muscle will be preserved on roentgenograms of the kidney, ureter and bladder and at times bulging of the lateral border of the muscle may be noted.

The following case report typifies the syndrome and introduces a pathognomonic roentgenographic sign.

REPORT OF A CASE

A 19 year old soldier, identical twin, with no past record or familial history of bleeding, was well until twelve days prior to his admission to the hospital, when he executed a jackknife dive from a 12 foot (3.6 meter) board, twisted his body to the left in midair and felt a sudden tearing pain in the right lumbar region. The pain disappeared and did not prevent him from swimming about and later from performing his normal duties, which included long marches. Several days later he noticed dull aching pain in the right side of his back, and in the week prior to his admission to the hospital the pain became more severe and constant. The pain was increased on walking and deep breathing and was not relieved by change in position. A sensation of soreness in the scrotum was noted for approximately one week, and the patient felt as if he had been kicked in that area. The urine was said to have been slightly red several days prior to hospitalization, but it was otherwise normal. When he walked about he felt as if his right leg was weaker and shorter than his left. There were no urinary or digestive symptoms. He had felt warm for several days, and the night before hospitalization he had noted a slight chill.

3. Alpert, L.: Report of a Case of Psoas Abscess Resulting from Tuberculosis of the Cervical Spine, New England J. Med. **211**:675, 1934.

On admission to the hospital the soldier appeared to be moderately ill and in severe pain. He assumed a supine position, turning slightly to the left with the right knee and thigh moderately flexed. On examination fulness in the right flank was noted, with severe spasm and prominence of the lateral costal interdigitations of the right latissimus dorsi muscle. The tenderness in the right costovertebral angle was exquisite and could be followed forward to the flank. There was extreme scoliosis of the lumbar spines to the left, with concavity toward the right. An apparent but not actual shortening of 1 inch (2.5 cm.) of the right leg was noted. No tenderness was evident over the vertebral spines and the paravertebral muscles. The abdomen was flat, with slight tenderness on deep pressure in the right upper quadrant. Slight hyperesthesia was displayed in the right groin along the course of the ilioinguinal nerve, with subjective soreness over the scrotal skin. Ludloff's sign (to be discussed later in the paper) was positive. The reflexes were normal.

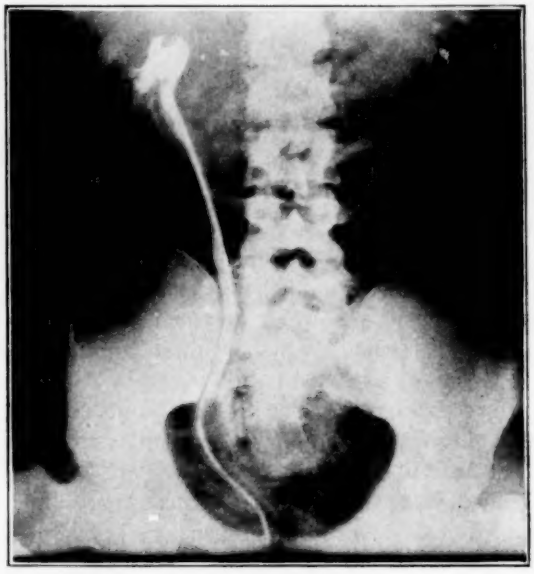

Fig. 1.—Pyelogram showing a normal pelvis and calices and definite lateral deviation of the upper third of the right ureter and the lower pole of the right kidney.

The temperature was 101 F., the pulse rate 100 and the respiratory rate 20. The red blood cell count was 4,600,000, with a hemoglobin content of 80 per cent; the white cell count was 11,000, with 73 per cent polymorphonuclear cells. A roentgenogram of the abdomen revealed normal shadows of the psoas muscle and vertebrae. Repeated examinations of the urine gave negative results for albumin, casts and cells. Cystoscopic examination showed a normal bladder with normal renal function and obstruction of the right ureter. A retrograde pyelogram (fig. 1) revealed a normal pelvis and calices and definite lateral deviation of the upper third of the right ureter and the lower pole of the right kidney.

The diagnosis of a mass in the right psoas muscle, which was pushing the kidney and ureter lateralward into the lumbar fossa, was thus established. In view of the history of acute trauma the mass was thought to be an infected hematoma. The patient was given sulfathiazole but continued to have a remittent fever, with a temperature which hovered about 101 F. He complained of a great deal of pain in the right side

of the back and in the right thigh, and the scoliosis and the flexion contracture of the right thigh increased. Four days after his admission to the hospital operation was performed and an infected hematoma of the right psoas muscle drained through a modified Faxon[4] incision. This incision, rather than the classic exploratory lumbar incision, was used because extension of the suppurative process into the subphrenic space was anticipated. With the patient under spinal anesthesia induced with tetracaine hydrochloride an oblique incision was made in the right posterior axillary line over the twelfth rib, and the distal 3 cm. of the rib was resected. The muscles were split at the level of the first lumbar vertebra, the peritoneum together with Gerota's fascia was pushed forward and the psoas muscle was found to be covered by a dull gray edematous fascia. Incision through the sheath revealed a large cavity containing pus and blood. The cavity measured 10 cm. in length and 5 cm. in diameter and was situated at the level of the first, second and third lumbar vertebrae. There was no extension of the inflammation to the subphrenic or the periphrenic space. A large Penrose drain was inserted into the cavity, and the wound was closed in layers about the skin. Cultures of pus revealed Staphylococcus aureus nonhaemolyticus. The temperature gradually returned to normal. The drains were slowly removed, and the drainage disappeared in fifteen days. Six weeks after the operation, cystoscopy showed a normal bladder and renal function, and retrograde pyelograms revealed normal shadows of the psoas muscle with no evidence of lateral deviation of either the ureter or the kidney (fig. 2). Ludloff's sign was negative postoperatively. The patient was discharged to full military duty, and a follow-up letter six months later reported the soldier to be completely well and on active military duty.

Fig. 2.—Pyelogram taken six weeks after the operation, showing normal shadows of the psoas muscle with no evidence of lateral deviation of either the ureter or the kidney.

4. Faxon, N.: Logical Approach to Subphrenic Abscess, Am. J. Surg. **54**:114, 1941.

COMMENT

Injuries of the psoas muscle are rare, and Strandell's report of 13 cases contained only 8 authentic cases of rupture of a normal muscle. All these 8 cases involved young men; 3 of the ruptures occurred while the men were lifting heavy weights; 2 occurred when the men fell backward; 1 happened while the man was in a split position and 2 occurred while the men were jumping over a fence or somersaulting over a box. The case reported here can be likened to the last in that the soldier incurred his injury while twisting his body in a jackknife dive.

The typical clinical picture in these cases is sudden intense pain in the lower portion of the abdomen, in the flank or in the hip, often accompanied by a knocking sound, which is said to be characteristic of rupture of a tendon. The pain disappears quickly as a rule, and the patient is able to work for hours or days before the pain returns. The victim begins to walk with a limp and notes difficulty in raising the affected leg. In this case the soldier felt that his right leg was shorter than his left.

Ludloff's sign[1] is said to be positive in all cases of severe irritation and rupture of the psoas muscle, and it was positive in this case. The sign is positive when the patient can flex the thigh while in the recumbent position but is unable to lift the thigh while in a sitting position with the hips flexed at 90 degrees. The test depends on the flexion activity of the rectus femoris and the tensor fascia lata muscle without aid of the psoas muscle with the patient in the supine position. When these muscles are relaxed with the patient in the sitting position disability of the psoas muscle prevents flexion or lifting of the thigh. In this case the sign was positive before and negative after operation. The hip joint is free with passive motion at first, but later flexion contracture and pain prevent mobility of the joint.

A distinct mass is usually felt below the inguinal ligament, although at times fulness alone may be noted in the abdomen, the iliac fossa or the lumbar region.

Neural lesions have been reported in association with trauma to the psoas muscle; in 1 case there was involvement of the femoral nerve with paralysis of the quadriceps femoris and adductor muscles and loss of sensory function of the lateral femoral and the saphenous nerve. In the case reported here there was temporary sensory im-

pairment of the ilioinguinal nerve. Tallroth [5] said that 5 cases of hemophilia associated with spontaneous hemorrhage in the iliopsoas muscle have been reported in the literature. He described a sixth case in which there was also temporary paralysis of the femoral nerve. The prognosis is usually good for both motor and sensory paralysis of nerves as long as operation with decompression of the intramuscular pressure is performed early.

In the reported cases the psoas muscle was poorly visualized or obliterated when the sheath was torn and blood diffused beyond the confines of the muscle. Bulging of the lateral border of the psoas muscle was noted in 1 case. Deviation of the ureter and kidney by a mass in the psoas muscle has been noted, but no emphasis has been placed on its diagnostic importance. McNally and Case [6] reported on an echinococcus cyst of the psoas muscle which produced definite lateral deviation of the upper urinary tract. Beer's [7] report described ureteral deviation in 2 cases of abscess of the psoas muscle which were first thought to be cases of perinephritic abscess.

Extravasated blood in muscle tissue may become absorbed, produce loculated cysts, calcify or become infected. Beer [7] mentioned a case of abscess of the psoas muscle with a loculated calcific mass which might have been due to previous injury. If infection supervenes by vascular or lymphatic extension, chills and fever appear. This usually occurs, according to Racz,[8] in seven to eight days after the acute injury. With the onset of suppuration there is an increase in pain with radiation down the thigh, and the patient appears extremely ill. The infection may become localized or may spread downward toward the lesser trochanter. If the iliac bursa is involved, signs resembling coxitis with severe pain on motion of the hip joint may be noted. In a small percentage of cases in which the iliac bursa communicates with the hip joint secondary synovitis will occur. The suppurative process may break through the fascia at the lesser trochanter and present beneath the inguinal ligament as a subcutaneous abscess. The abscess may penetrate the anterior sheath of the psoas muscle, giving rise to peritoneal irritation, paralytic ileus and clinical signs of an intra-abdominal mass. It is possible for the abscess to invade Gerota's fascia with formation of a perinephritic abscess, to perforate the peritoneum with consequent peritonitis and in rare instances even to rupture into contiguous bowel.[8] Infection occurred in 25 per cent of Strandell's cases, with no fatalities. Two of the 5 patients with hemophilia reported on by Tallroth became infected, and 1 died.

Differentiation of abscess of the psoas muscle from other disease may at times be difficult. In those cases in which there is a mass in the psoas muscle with no history of acute injury or constitutional symptoms of acute suppuration, the possibility of arthritis of the spine due to tuberculosis should be considered. The Mantoux test and roentgenograms will usually reveal the etiologic factor. Osteomyelitis of the femur may start clinically with contracture of the psoas muscle, and careful examination will usually show local tenderness; roentgenograms will reveal normal shadows of the psoas muscle and of the upper part of the urinary tract. So-called primary psoitis [9] occurring in young children from furunculosis or by lymphatic extension from infection of the skin or bones of the lower extremities will produce the typical syndrome of trauma to the psoas muscle. In this syndrome the onset is acute, no previous traumatic episode is noted and examination reveals pronounced flexor contraction, occasional neuralgic symptoms and a positive Ludloff sign. Roentgenograms will show normal shadows of the psoas muscle, but if suppuration ensues the obturator muscle sign (bulging of the medial outline) will be present. Perinephritis may give a similar history and signs, but roentgenograms will usually reveal obliteration of the psoas muscle and normal position of the ureter and kidney. Perforation of the appendix,[10] sigmoid diverticulitis [11] and perforation of the ileum by a foreign body [12] have been reported as the cause of abscess of the psoas muscle, and these possibilities should be entertained. Subphrenic abscess may simulate suppuration in the psoas muscle, but careful roentgenographic and fluoroscopic examination of the diaphragm should locate the lesion.

There are no doubt numerous minor degrees of trauma to the psoas muscle which may produce

5. Tallroth, A.: Hemophilia with Spontaneous Hemorrhage in the Iliopsoas Muscle Followed by Injury to the Femoral Nerve, Acta chir. Scandinav. **82**:1, 1939.

6. McNally, A., and Case, J. B.: Echinococcus Cyst of the Left Psoas Muscle, Am. J. Surg. **51**:419, 1941.

7. Beer, E.: Psoas Muscle Abscess Simulating Perinephritic Abscess, J. Mt. Sinai Hosp. **4**:928, 1938.

8. Racz, B.: Acute Psoas Abscess Arising in Sports, Zentralbl. f. Chir. **64**:452, 1937.

9. Schroeder, E.: Primary Psoitis, Acta chir. Scandinav. **81**:138, 1938. Cohen-Solal, L.: Acute Primary Suppurations Developing in the Sheath of the Iliopsoas, Rev. de chir., Paris **74**:534, 1936; abstracted, Surg., Gynec. & Obst. **64**:162, 1937.

10. McCorkle, H., and Stevenson, J.: Psoas Abscess of the Appendix, Surgery **3**:547, 1938.

11. Lyall, A.: Acute Psoas Abscess Caused by Diverticulitis, Brit. J. Surg. **24**:192, 1936.

12. Sinclair, A. S.: A Case of Psoas Abscess Not Due to Osteomyelitis of the Spine But to Foreign Body, Canad. M. A. J. **45**:157, 1941.

mild pain in the back and contiguous intestinal irritation. The cause in some cases of meralgia paresthetica may be subcutaneous injury of the psoas muscle. Pain in the back associated with paresthesia along the saphenous, lateral femoral cutaneous and genitofemoral nerves should suggest injury of the psoas muscle. Mild fibrillar injury of the psoas muscle should be treated conservatively with rest and local heat. In those cases in which there are associated mild vasomotor changes and no involvement of peripheral nerves the treatment is expectant, but if signs of neuritis or infection supervene operation is indicated. For all large hematomas in the absence of a blood dyscrasia, incision and drainage should be practiced. The incision depends on the site of the mass in the psoas muscle. In the iliac fossa the best surgical approach is the longitudinal incision of Ludloff; one searches for the abscess on the medial aspect of the thigh between the gracilis and the adductor longus muscle, going through the pectineus muscle, and should locate it either within or without the iliopsoas muscle.[13] In masses above Poupart's ligament, the Gibson extraperitoneal incision for exploration of the lower ureteral region is excellent. In masses in the upper portion of the psoas muscle the approach may be made through the usual lumbar renal exploratory incision or a modification of Faxon's posterior subphrenic incision.

13. Freiberg, J. A., and Perlman, R.: Pelvic Abscesses Associated with Acute Purulent Infection of the Hip Joint, J. Bone & Joint Surg. **18**:417, 1936.

SUMMARY

A patient with an infected hematoma of the psoas muscle presented the typical clinical syndrome associated with trauma to the psoas muscle.

With this syndrome a history of sudden pain associated with violent exercise followed by a latent asymptomatic period and subsequent pain and disability is obtained. Examination reveals flexion contracture of the thigh with adduction and external rotation. There are scoliosis of the lumbar vertebrae away from the affected side and apparent shortening of the leg on the affected side. A mass or fulness is found in the flank, abdomen, iliac fossa or infrainguinal region. A normal outline of the psoas muscle is seen on roentgenograms, and lateral deviation of the upper third of the ureter and the lower pole of the kidney on retrograde pyelography is noted. Irritation of nerves is found in acute large hemorrhagic extravasations, with complete recovery following adequate drainage. Complications of hemorrhage in the psoas muscle include formation of cysts, calcification and infection. Occasionally abscesses of the psoas muscle may perforate into perinephric and peritoneal spaces and contiguous bowel. If the abscess descends to the level of the lesser trochanter, bursitis, synovitis or subcutaneous abscess may result. The syndrome should be differentiated from perinephritis, coxitis, osteomyelitis of a vertebra or of the femur, primary psoitis and intra-abdominal abscess. Early operation results in recovery and no permanent disability.

EXPERIENCE WITH CALCULUS OF THE BLADDER IN NORTH CHINA

PHILIP B. PRICE, M.D.
SALT LAKE CITY

Calculus of the bladder is endemic in parts of China. Thomson [1] reported 2,949 lithotomies performed at the Canton Hospital between the years 1861 and 1919. Olpp and Kuhne,[2] in the same province observed 189 cases of vesical calculus in nine years. Cochran [3] in Anhwei Province, in Central China, treated 227 patients with calculus of the bladder in the course of twelve years. In five years I saw about 150 patients with vesical calculus at the University Hospital in Tsinan, capital of Shantung Province; 126 of these patients admitted for treatment form the basis of this report.

Shantung is a northern coastal province. The dense population, estimated at about 38,000,000, is largely rural, wresting a subsistence from the arid soil by means of a primitive system of irrigation. Although the winters are long, the total number of hours of sunshine during the year is large.

INCIDENCE

Three fourths of the patients with vesical calculus came directly from the country; the remainder gave city or town addresses, but the latter group included several boys of farmer stock who were attending school in the city. All of the patients, without exception I believe, belonged to the poorer classes of society; 4 were beggars.

In the present series, 121 patients were males and 5 were females.

The age incidence was remarkable. Seventy-four per cent of the patients were between 5 and 15 years and only 7 per cent over 25 years of age. In 35 per cent of the series urinary symptoms began during the first three years of life, and in 72 per cent the onset of symptoms was before the age of 7 years.

Symptoms frequently started in the spring; exacerbations of symptoms were most common in the spring months and least common during the summer.

ETIOLOGY

Infravesical obstruction was found in only 4 per cent of the patients. Three patients had stones which had formed around a foreign body in the bladder. There was no evidence from the history, physical examination or analysis of the vesical calculi that renal stone had occurred in any of these patients or that it had played a part in the pathogenesis of the disease. In fact, renal stone was rarely observed in that province.

Shantung is a dry region with extremes of temperature. The water is extremely hard. It is noteworthy that the patients were most free of symptoms in the hot summer months, when consumption of water is large but when the urine is likely to be concentrated.

The seasonal incidence of symptoms suggests a dietary factor in the pathogenesis. During the long winters the people, if poor, subsist chiefly on cereals, vegetable oils and vegetables poor in color. Children are commonly weaned after the second or third winter, and during the next three or four years they are fed largely on cereals, especially in winter. Although in summer there is a larger variety of foods available, even for the poor, evidences of vitamin deficiency are found commonly in patients of all ages, but especially in children. Some of my patients with vesical stone complained of night blindness. Furthermore, many of the little country children run naked, or nearly naked, in the bright sunshine during the warm months of the year. It is probable, therefore, that hypervitaminosis D and vitamin A deficiency coexisted in many instances, a combination which has been used to produce urinary calculi experimentally in animals.[4]

From the Department of Surgery, University of Utah School of Medicine.

1. Thomson, J. O.: Lithiasis at the Canton Hospital, China M. J. **35**:347, 1921.

2. Olpp and Kuhne, cited by Jefferys, W. H., and Maxwell, J. L.: Diseases of China, Including Formosa and Korea, Philadelphia, T. Blakiston's Son & Co., 1910, pp. 540-586.

3. Cochran, S.: Choice of Operation in Vesical Calculus, China M. J. **27**:285, 1913.

4. Best, C. H., and Taylor, N. B.: The Physiological Basis of Medical Practice, Baltimore, Williams & Wilkins Company, 1943, p. 1211.

SYMPTOMS

Most of the patients had a far advanced condition, having been brought to the hospital as a last resort. The duration of symptoms ranged from five days to thirty years, the average being five years. A history of attacks with symptom-free intermissions was characteristic. The following incidence of symptoms was noted:

Symptom	Percentage
Pain	96
Penile	86
Suprapubic	28
Perineal	17
Lumbar	7
Rectal	1
Referred to thighs	1
Difficulty in micturition	91
Frequency	76
Pulling on penis for relief of pain	64
Hematuria	45
Urine expressed drop by drop	42
Stoppage of urine	40
Standing on head and shaking body for relief of stoppage or of pain	38
"Chalky" urine	25
Protrusion of anus or prolapse of rectum	21
Passage of small stones or sand	16
Incontinence of urine	15
Acute retention of urine	5

DIAGNOSIS

In an advanced stage the symptoms were so typical that the diagnosis was rarely in doubt.

In 30 per cent of patients the stone or stones could be felt through the rectum. The ability to do so usually indicated a large stone fixed in position by a contracted bladder, by adhesion to the bladder wall or by impaction in the prostatic portion of the urethra.

Roentgenographic examination rarely failed to provide reliable and accurate information regarding the number, size, position and even structure of the stones. Two patients had stones which cast no shadows, and 1 patient (not in the present series) who had urethral obstruction and roentgenographic signs of vesical stone was found at operation to have a greatly thickened, contracted bladder filled with chalky urine, but no stone. Multiple calculi were not uncommon, but the usual finding was a single large calculus. The largest stone encountered was hourglass in shape and 9 cm. long and weighed 235 Gm. The patient had had symptoms for thirty years.

Cystoscopic examination was not employed routinely. Since most of the patients were small children and poor surgical risks, it did not seem wise to subject them unnecessarily to the additional administration of an anesthetic and the trauma of a cystoscopic examination. Even in adults it was often impossible to carry out satisfactory cystoscopic examinations because of severe cystitis, contracted bladder or stones impacted in the urethra.

Two patients had obstructive phimosis; 1 had a traumatic stricture of the membranous urethra and 2 had strictures following gonorrhea. There were no cases of prostatic enlargement or obstruction.

Some degree of cystitis was almost always present; many patients had gross infection. Usually, on the patients' admission to the hospital, the bladder was irritable and spastic and would tolerate only a small quantity of urine or instilled fluid, but great improvement usually resulted after a few days of simple drainage and gentle irrigations. Some bladders were contracted and fibrosed, however, and improved only slightly during the preoperative regimen.

More than half the patients on hospitalization showed serious impairment of renal function, as measured by excretion of phenolsulfonphthalein; however, many of these patients improved remarkably during the preoperative period. The patients with the most severe involvement had tenderness in the costovertebral angles and an increase in the nonprotein nitrogen of the blood, and they excreted only traces of phenolsulfonphthalein in two hours.

Many of the patients were malnourished. Anemia and hypoproteinemia were frequently observed. Intestinal parasites were present in almost every case. Protrusion of the anal mucosa or true prolapse of the rectum from excessive straining was not uncommon in the younger children. A minor, but annoying, complication was dermatitis, due to incontinence of urine.

PREOPERATIVE TREATMENT

Because of the poor physical condition of many of the patients, emphasis was laid on unhurried, adequate preoperative care. Rest in bed, sedation, use of an indwelling urethral catheter, gentle irrigations and instillations, administration of urinary antiseptics by mouth, institution of a high caloric diet, treatment of anemia and intestinal parasites, correction of fluid and electrolytic balances and general nursing care seldom failed to bring about pronounced general improvement. Especially important was employment of the indwelling catheter; if properly placed, it usually relieved the pain and spasm to a large extent and provided for the all-important free drainage of urine.

Two patients with tightly impacted stones and acute retention required suprapubic aspiration of urine; 2 others required preliminary suprapubic cystotomy. It was found advisable to place the

latter patients prone on a Bradford frame, so that the urine would drain freely, dripping into a pan.

SUPRAPUBIC LITHOTOMY

The procedure to be described was evolved at the University Hospital during a period of several years.

Operative Technic. — Immediately before operation, preferably before induction of the anesthesia is started, a relatively large soft rubber catheter is introduced through the urethra and the bladder is irrigated repeatedly with isotonic solution of sodium chloride or a solution of boric acid until the fluid returns clear. No force other than gravity is used in the irrigation, the fluid being poured into the barrel of a large glass syringe, the nozzle of which is connected directly to the protruding end of the catheter. The capacity of the bladder under such conditions is noted; frequently it is not more than 50 or 75 cc. when this small amount of pressure is used. After the irrigation, the piston of the syringe is engaged, and a corresponding amount of air is injected slowly into the empty bladder. The catheter, pinched with a clamp, is left in place. This gentle irrigation and measured inflation obviate all danger of rupture of an ulcerated bladder wall or of air embolism; it will not even cause bleeding of congested mucosa.

The suprapubic region is cleaned and draped. A vertical midline incision is made about twice the length of the smallest diameter of the stone, as seen on the roentgenogram. The pyramidalis muscle, which may be greatly hypertrophied, is best split in the midline from below upward. Care is taken not to bare the pubic bone. The anterior surface of the bladder is disturbed as little as possible, the peritoneal reflection being rubbed upward gently with gauze in the midline only. Nicking or tearing the peritoneum at this stage is of no consequence provided the defect is observed and is closed promptly and completely. It is not necessary to discontinue the operation on that account.

The presenting wall of the bladder is held forward with two traction sutures of medium silk, which pass through all the coats of the viscus. This maneuver not only prevents the surgeon from losing his way while dissecting through the sometimes thick fibrous bladder wall but keeps the mucosa from retracting and thus facilitates subsequent closure. The circulating nurse then reaches a hand under the drapes and removes the clamp from the catheter, so that any fluid inadvertently left in the bladder may have an opportunity to escape. The bladder wall is incised vertically, the two large midline veins being avoided if possible. This incision, which is about one and a half times the diameter of the stone, is first carried to but not through the mucous membrane, so that full hemostasis may be secured before the vesical cavity is opened. This is an important point, for blood in the bladder may ruin all chances of a smooth postoperative course. A nick in the mucosa permits air in the bladder to escape harmlessly, but should any fluid appear the opening is promptly closed by crossing the traction sutures until the fluid is aspirated by means of a syringe, with a long blunt nozzle thrust through the hole in the mucosa. The escape of any of this infected fluid into the incision is to be avoided, since it results almost inevitably in postoperative infection and leakage of urine. The mucous membrane is now opened widely, exposing the stone in the base of the bladder.

At this point the surgeon inserts his finger cautiously into the bladder. If the stone is adherent to the wall of the bladder, it must be freed gently. The stone is brought forward on the finger and is rotated, so that it may be grasped across its shortest diameter with an appropriate forceps introduced alongside the finger. Finger, forceps and stone are removed, particular care being taken not to contaminate the wound. In the case of a large stone it is well to protect the wound first with dry gauze. The finger is now introduced again, and the entire vesical cavity is palpated systematically for other stones, diverticula, incrustations, polypi or other abnormalities. If none is found, the circulating nurse again reaches under the drapes and pulls on the catheter until the internal end lies in proper position, protruding about an inch (2.5 cm.) into the bladder. Thereupon the palpating finger is withdrawn without contaminating the wound, and the surgeon changes his gloves. The bladder should not be irrigated during the operation, since nothing of value is accomplished thereby, but much harm may be done by infecting the incision.

The bladder wall is usually closed without drainage in three layers. First, the mucosa is repaired with continuous suture of 000 plain surgical gut, much as the peritoneum is closed after a McBurney incision. This step, which is contrary to the usual teaching, was adopted because it restores normal anatomic relations, reduces to a minimum the defect as seen from within the bladder, prevents bleeding into the bladder and lessens the chances of postoperative leakage of urine. Next, the muscular (or fibrous) walls are approximated accurately without invagination with several interrupted sutures of 00 or 0 chromic surgical gut. Finally, the loose areolar tissue on the anterior surface of the bladder is drawn over the defect with a continuous suture of fine plain surgical gut. The abdominal wall is closed, a small rubber drain being left in the space of Retzius. To insure immobility, the catheter is anchored with sutures in the prepuce.

The technic just described was at first employed only in favorable cases, but gradually I have come to use it with satisfaction as a routine, except in the presence of large, tightly impacted stones. Those stones present special problems. Before operation it may be impossible to gain a clear idea of the condition of the bladder or kidneys, and treatment is hampered by inability to drain the bladder by a urethral catheter. At operation extraction of the stone is sometimes extraordinarily difficult, especially if it is hourglass in shape with the constriction tightly grasped by the neck of the bladder. In such instances it has been found helpful to work bimanually, with one finger in the bladder and a finger of the other hand under the sheets in the rectum. Since these bladders and stones are usually heavily infected, contamination of the incision can scarcely be avoided; consequently, it is best to drain the bladder suprapubically. I have never encountered a stone that could not be removed suprapubically, but there were several stones in the present series which probably could not have been removed successfully by any other route.

Postoperative Care.—The urethral catheter is connected to a rubber tube, which drains into a bottle beside the bed. Special care is taken to keep this drainage system working continuously and efficiently, otherwise the bladder may become distended and leak into the prevesical space. The bladder is not usually irrigated after operation, but abundant fluids are given to keep it flushed out. If all goes well, the suprapubic drain is removed on the third or fourth day after operation and the catheter on the fourth to the sixth day. Children whose incisions have healed by first intention may safely be let out of bed after a week. The urine,

if alkaline, should be rendered acid. Dietary and general hygienic measures are continued, and before discharge from the hospital the patient or his parents are given advice regarding the future diet and the intake of fluids.

RESULTS

Since the treatment just described was developed during a period of years, it was applied in its entirety only to the more recent patients in the present series. It is thus possible to compare the results of different operative technics in the same clinic.

In 12 patients the bladder was drained suprapubically after removal of the stones. Perhaps the condition of these patients was the most serious; at any rate, the results were comparatively poor. Hospitalization averaged sixty days, and an average of forty days was required before leakage of urine from the incision ceased entirely. All the patients had an uncomfortable, and some of them a stormy, convalescence. Two died.

In 36 patients the bladder was closed without drainage, although no particular care had been taken to avoid contamination of the wound with contents of the bladder. In some instances the bladder had been distended with fluid, which escaped when the viscus was opened; in others retained urine had been the source of infection, and in still others the infected bladder had been irrigated during operation. These patients were in the hospital an average of thirty-one days. In 70 per cent the wounds became infected to a greater or less extent, and 66 per cent had postoperative leakage of urine from the incision. Only 22 per cent had healing without leakage or infection. There were no deaths.

In 35 patients all the essential features of the treatment which I have described were successfully carried out. The average stay of these patients in the hospital was eighteen days; in 16 per cent the wounds showed some infection, 8 per cent leaked and 84 per cent healed with neither leakage nor infection. There were no deaths. My personal series included 18 of these patients, for whom the average time from operation to discharge from the hospital was eleven days; 1 of the wounds showed slight infection.

A fourth, miscellaneous, group included 2 patients who refused operation, 2 who were moribund on admission to the hospital and died without operation and about 40 seen early in the series for whom various methods, later abandoned, were tried.

Urinary incontinence did not occur postoperatively in any case.

The operative mortality for the entire series, which represents the work of nine general surgeons, including junior men of the resident staff, was 1.6 per cent.

Fortunately, autopsies were made on the 4 patients who died. One patient had bilateral hydroureter and hydronephrosis; 2 had bilateral pyelonephrosis, and the fourth had hydronephrosis on the right side and pyelonephrosis with multiple abscesses in the cortex, extensive perinephritic infection and beginning empyema on the left side. Lithotomy was attempted with 2 of these patients; the other 2 died without operation shortly after admission to the hospital, despite drainage of the bladder with a catheter. All 4 patients had tenderness in the lumbar region; 3 had fever, and none excreted more than a trace of phenolsulfonphthalein in two hours.

A number of adult convalescents were examined cystoscopically one to two weeks after operation. The bladders which had been closed as described showed smooth healing, with little or no reaction, whereas those closed in the conventional manner usually showed invagination of uncovered vesical muscle with some surrounding inflammatory reaction.

It was not possible to follow most of these patients after their discharge from the hospital. Since they left pleased and grateful and none returned with vesical symptoms, it may be assumed that few, if any, had recurrence of stone during the period covered by this study. There were 2 patients with recurrent stone in the present series, however, both patients having been operated on previously elsewhere. In 1 the stone obviously had formed around a silk suture, which was still attached to the bladder wall.

COMMENT

Neither perineal lithotomy nor the crushing operation was employed in the present series of patients. The former is a destructive procedure, which probably should be reserved for stones associated with prostatic disease (Young [5]). Litholapaxy was contraindicated in virtually every case because of stricture, small urethra, impaction, large stone, severe cystitis, spastic or contracted bladder or other conditions.

The method of treatment described in this paper does not contain many new features; its value lies rather in the application of well recognized surgical principles and the sequence of certain essential steps. Briefly these are: (*a*) accurate diagnosis, which includes not only the demonstration of stones but an appraisal of the

5. Young, H. H.: Practice of Urology, Philadelphia, W. B. Saunders Company, 1926, vol. 1, p. 368; vol. 2, pp. 335 and 405.

condition of the entire urinary tract and of the body as a whole; (*b*) unhurried preoperative treatment which aims toward lessening intravesical infection, improving renal function and bettering the general condition of the patient; (*c*) suprapubic lithotomy without contamination of the wound; (*d*) anatomic closure of the bladder without suprapubic drainage; (*e*) continuous drainage of the bladder for four or five days by means of a urethral catheter, and (*f*) attempts during the postoperative period to bring the patient and his urinary tract back as nearly as possible to normal.

The results of lithotomy have been reported for the most part in the older literature. Watson and Cunningham,[6] in a study of nearly 34,000 collected cases, found for children a mortality of 7.4 per cent for suprapubic lithotomy, of 3.3 per cent for perineal lithotomy and of 1.7 per cent for litholapaxy; for adults there was a somewhat higher mortality with all three types of operation. These authors pointed out that as a rule in the more difficult cases the patients come to suprapubic operation, a fact that should be kept in mind when mortality rates are compared. In the series at the Canton Hospital[1] the mortality rate was 7.8 per cent for the suprapubic operation, 7.9 per cent for the perineal operation and 9 per cent for the crushing operation. Cabot[7] reported a mortality of 10 per cent for suprapubic lithotomy for children under 14 years and an even higher per cent for adults. Olpp and Kuhne[2] reported a total mortality of 7.2 per cent; Roys,[8] 18.7 per cent, and Cochran[3] 3.9 per cent. Joly[9] had a mortality of 2.2 per cent from litholapaxy. Walker's large personal series[10] from India and England had an over-all mortality of 3.87 per cent for the three types of operation. Much of this work was done in China or India on advanced conditions under unfavorable circumstances, and before the introduction of modern physiologic concepts of preoperative and postoperative care. Obviously it would be unfair to compare the results in my small series with those just listed; on the other hand, my results should not be compared indiscriminately with those obtained by litholapaxy in selected, early, uncomplicated cases of vesical stone.

A favorable showing is made, however, by the method here recommended from the point of view of length of hospitalization, healing of wounds without infection or leakage of urine and absence of other postoperative complications. This procedure is applicable in all cases of early vesical calculus and in more than 80 per cent of cases of the advanced condition, such as those described in this report.

SUMMARY

Calculus of the bladder is endemic in Shantung Province, in northern China. This report is based on a study of 126 patients admitted to a small general hospital during a five year period.

The peculiar characteristics of incidence of stone in that locality suggest a dietary factor in the pathogenesis.

Most of the patients had a far advanced condition; many were recognized as poor surgical risks.

The results of the treatment employed, which is described in detail, on the whole were satisfactory. Many patients had an uncomplicated convalescence, with primary healing of the suprapubic incision. The operative mortality for the entire series was 1.6 per cent. No recurrences were observed.

Salt Lake General Hospital.

6. Watson, F. S., and Cunningham, J. H.: Diseases and Surgery of the Genito-Urinary System, Philadelphia, Lea & Febiger, 1908, vol. 1.

7. Cabot, A. C.: Stone in the Bladder, in Keen, W. W.: Surgery, Philadelphia, W. B. Saunders Company, 1916, vol. 4, p. 347.

8. Roys, C. K.: The Choice of Operation for Vesical Calculus, China M. J. **24**:259, 1910.

9. Joly, cited by Herman, L.: The Practice of Urology, Philadelphia, W. B. Saunders Company, 1938, p. 841.

10. Walker, J. W. T.: Operations for Vesical Calculus, in Burghard, F. F., and Kanavel, A. B.: Oxford Loose-Leaf Surgery, New York, Oxford University Press, 1920, vol. 3, pt. 2, p. 714.

MASKED TRAUMATIC RUPTURE OF THE SPLEEN

JOSEPH K. NARAT, M.D., AND ANGELO L. VINCENTI, M.D.
CHICAGO
AND
ARTHUR F. CIPOLLA, M.D.
CICERO, ILL.

Rupture of the spleen occurs, according to statistics, with 30[1] to 47.6[2] per cent of contusions of the abdominal viscera. In view of this relatively high frequency of the condition it is essential for every surgeon to be familiar with its signs and symptoms. Inasmuch as the mortality for ruptured spleen, ranging from 93[3] to 100 per cent,[4] can be reduced by an operation to 10 per cent,[4d] it is self evident that early recognition of the injury is imperative, so that surgical intervention can be instituted without delay.

For practical purposes, two clinical pictures of traumatic rupture of the spleen may be distinguished:

1. The initial injury produces a rapidly progressive hemorrhage, with the following symptoms and signs, in descending order of frequency[5]: generalized abdominal pain, 100 per cent; tenderness, 95 per cent; rigidity, 85 per cent; shock, 65 per cent; dulness on percussion, 50 per cent; vomiting, 35 per cent; localized pain, 30 per cent, and abdominal distention, 15 per cent. A history of trauma to the left upper quadrant of the abdomen combined with the aforementioned signs is strongly suggestive of rupture of the spleen.

Few signs are pathognomonic of rupture of the spleen. Irritation of the left side of the diaphragm by accumulation of blood may cause abdominal pain with radiation to the left scapula (Kehr's sign). Roentgenograms may reveal increased density in the affected region and abnormal elevation of the left side of the diaphragm, in addition to displacement of the stomach to the right or compression of the fundus. Palpation discloses a tender, indefinite mass in the left upper quadrant of the abdomen. Dulness on percussion may be present not only in the left upper quadrant and the left flank but in the right flank; on the shifting of position the dulness in the right flank disappears (Ballance's sign).

The differential diagnosis should consider fracture of the lower ribs on the left side, traumatic pleurisy, laceration of the liver or the left kidney, rupture of a hollow viscus and ectopic pregnancy. Simple contusion of the abdominal wall without injury of the internal organs does not affect the pulse rate, the blood pressure or the blood cell count. In doubtful cases Wright and Prigot[2] advocated diagnostic tapping of the abdomen.

2. After recovery from the initial injury, which may be trifling, an asymptomatic or latent period is followed by a delayed, recurrent hemorrhage (*hémorragie en deux temps*). The usually abrupt onset of the secondary hemorrhage initiates a clinical syndrome consisting of abdominal pain, rigidity and tenderness, soon followed by shock or collapse. However, the secondary hemorrhage may not start dramatically with acute symptoms of loss of blood but may have an insidious onset.

Zabinski and Harkins[4d] stated that the ratio of incidence of delayed to immediate grave hemorrhage is 1 to 6. Great diagnostic difficulties are encountered in cases of delayed splenic hemorrhage. The apparent well-being of the patient during the latent period may create a false sense of security and may cause the attending physician to minimize the gravity of the situation.

The case to be reported is an instance of delayed splenic hemorrhage. For the sake of brevity only the most pertinent facts are mentioned.

From the St. Elizabeth Hospital.

1. Mazel, M. S.: Illinois M. J. **62**:170, 1932.

2. Wright, L. T., and Prigot, A.: Traumatic Subcutaneous Rupture of Normal Spleen, Arch. Surg. **39**: 551 (Oct.) 1939.

3. Berger, E.: Arch. f. klin. Chir. **68**:768, 1902.

4. (*a*) McIndoe, A. H.: Brit. J. Surg. **20**:249, 1932. (*b*) Puestow, C. B.: S. Clin. North America **20**:195, 1940. (*c*) Roettig, L. C.; Nusbaum, W. D., and Curtis, G. M.: Am. J. Surg. **59**:292, 1943. (*d*) Zabinski, E. J., and Harkins, H. N.: Delayed Splenic Rupture: Clinical Syndrome Following Trauma; Report of Four Cases with Analysis of One Hundred and Seventy-Seven Cases Collected from Literature, Arch. Surg. **46**:186 (Feb.) 1943. (*e*) Webb, R. C.: Journal-Lancet **59**:545, 1939. (*f*) Bailey, H. A., and Schreiber, S. L.: Am. J. Surg. **66**:4, 1944. (*g*) Wright and Prigot.[2]

5. Foster, J. M., and Prey, D.: Am. J. Surg. **47**: 487, 1940.

REPORT OF A CASE

Mrs. S. F., aged 24, fell on an icy sidewalk on Dec. 24, 1944 and struck her left flank against the curb. The pain experienced in the abdomen ceased after a few minutes, and only a slight ache remained. On the following two days the patient went about her work and forgot the initial injury; on the evening of December 26 she ran against a doorknob, which struck the left side of her abdomen. After this accident the pain became more accentuated; one hour later the patient fainted but regained consciousness within a short time. She had a moderate amount of pain during the following night and entered the St. Elizabeth Hospital on the morning of December 27. Soon after admission she vomited and had diarrhea.

Her past history was irrelevant. At the time of the first examination she did not appear acutely ill and did not offer any complaints of pain. The routine physical examination revealed essentially no abnormality. The temperature was 98.6 F.; the pulse was of good quality, with a rate of 96; the respiratory rate was 24, and the blood pressure was 98 systolic and 64 diastolic. The abdomen was neither rigid nor distended, and only a slight tenderness was present on pressure on its upper portion. The blood count showed 2,860,000 red cells, 13,000 white cells, 83 per cent neutrophils and 17 per cent lymphocytes. The hemoglobin content was 9.8 Gm. (Hayden-Hauser).

The roentgenogram revealed no air under the diaphragm.

In spite of the fact that there was no rigidity or marked tenderness of the abdominal wall and none of the common signs of acute hemorrhage, such as pallor, air hunger, cold and clammy skin, progressive increase in the pulse rate or decline of the systolic blood pressure, the low red cell count, together with a history of two traumas of the left upper quadrant of the abdomen, a fainting spell and vomiting, suggested rupture of the spleen.

With the patient under pentothal sodium anesthesia administered intravenously, the abdomen was opened through an upper midline incision. Liquid blood and several large clots were distributed throughout the peritoneal cavity. Approximately 250 cc. of blood was aspirated during the operation, and a considerable amount was removed with sponges. Inspection of the spleen disclosed a tear through the hilus, splitting the entire organ in two. The bridge connecting the two parts was approximately one-half the thickness of the organ. Blood was seen spurting from the splenic artery. Splenectomy was performed in the usual manner, and the abdomen was closed without drainage. Blood was obtained from a donor, and therefore the blood aspirated from the abdomen was not used for an autotransfusion. One hundred thousand units of penicillin was administered in five doses, the first before and the remaining four after the operation. The patient made an uneventful recovery.

The pathologic report was as follows: The specimen consisted of a spleen which weighed about 150 Gm. and measured 10 by 7 by 4 cm. Through the middle there was an irregular transverse tear, 5 cm. long, which almost cut the spleen in half and went through the attachment of the vessels.

On the third postoperative day the blood count showed 4,050,000 red corpuscles and 13,000 leukocytes, of which 86 per cent were neutrophils, 10 per cent lymphocytes, 3 per cent monocytes and 1 per cent eosinophils.

COMMENT

The interesting point in this case is the fact that the patient sustained two traumas forty-eight hours apart. It is a matter of conjecture which accident caused the rupture of the spleen. Probably the first accident was responsible for the laceration, while the second dislodged the hematoma, creating a secondary hemorrhage. The main reason for reporting this case is the low erythrocyte count, which increased the suspicion of internal hemorrhage, in spite of the fact that the customary clinical signs of rupture of the spleen were nearly completely masked. This observation is at variance with Babcock's [6] statement that with rupture of the spleen there is an early and rapid increase in leukocytes without a relative fall in hemoglobin and the red cell count.

The lesson to be drawn from this observation is the advisability of repeated blood cell counts in cases of contusion of the upper portion of the abdomen. Even if no clinical manifestations of a ruptured spleen are present, a falling erythrocyte count should be considered a warning signal, and an exploratory laparotomy should be performed without delay.

The diarrhea which occurred in our patient may possibly be explained by Bailey and Schreiber's [4f] hypothesis that the blood escaping from the lacerated spleen irritates the splenic flexure and the descending colon with production of contraction, thus causing loose bowel movements.

SUMMARY AND CONCLUSIONS

In the case reported, the patient sustained two successive insignificant traumas; the only sign observed during the latent period was a low erythrocyte count, which led to the diagnosis of ruptured spleen. The diagnosis was confirmed at operation.

In a case in which there is a history of contusion of the left upper quadrant of the abdomen the possible presence of a ruptured spleen should be borne in mind. It must be stressed that the clinical picture of an intraperitoneal hemorrhage may be deceiving and that a low erythrocyte count in such a case is a valuable diagnostic aid. Failure to recognize the condition may be responsible for a fatal outcome; therefore an exploratory operation should be performed without delay, even if no sign other than a low red cell count is present.

1200 North Ashland Avenue, Chicago.
718 South Kedzie Avenue, Chicago.
1234 South Fifty-First Avenue, Cicero, Ill.

6. Babcock, W. W.: Principles and Practice of Surgery, Philadelphia, Lea & Febiger, 1944, p. 1072.

PROGRESS IN ORTHOPEDIC SURGERY FOR 1943

A REVIEW PREPARED BY AN EDITORIAL BOARD OF THE AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS

XVIII. AMPUTATIONS, APPARATUS AND TECHNIC

PREPARED BY J. WARREN WHITE, M.D., GREENVILLE, S. C.

Amputations.—As would be expected during wartime, many articles on amputations have appeared. Nothing particularly new has been published, but ten or a dozen papers discuss the value of refrigeration as an appropriate anesthetic, particularly for extremely ill patients and for those in whom serious vascular disease exists, with or without gangrene.[606] Kennedy [607] emphasizes its importance in military service and in civilian practice, where it is so valuable in diabetic gangrene and vascular disease. Allen and Crossman [608] state the belief that thrombotic and embolic accidents are reduced by the use of refrigeration. The death rate in their cases has fallen from 60 to 15 per cent as the result of using refrigeration. The general consensus is that healing is to some degree retarded when refrigeration is employed, but to no serious extent, notwithstanding popular lay articles to the contrary, such as the brief paper by Doane,[609] which otherwise is a well worth while exposition of the subject in nontechnical language for hospital administrators. A successful amputation is reported by Dziob and Brown,[610] with complications of sepsis and a temperature of 108.4 F., for which refrigeration seemed particularly appropriate. The high temperature was attributed to a reaction to sulfathiazole, however, rather than to the sepsis. Johnson [611] also reports a reduced mortality rate for amputations as a result of refrigeration anesthesia as compared with other anesthesia.

One author [612] erroneously refers to refrigeration when he discusses anesthesia by freezing. Of course if actual freezing takes place real damage to the tissue ensues. This cannot occur if plain chipped ice is employed. One of the dangers, however, of using a positive refrigeration machine is that actual freezing might accidentally occur. No article in 1943 discusses the use of a mechanical refrigerator.

All articles except one recommend the use of refrigeration before the application of a tourniquet and are in agreement about the time necessary to allow the application of a painless tourniquet and the production of complete anesthesia in an extremity. Most articles recommend continuing the refrigeration of the stump from a few hours to a few days. Two articles [613] recommend that the icing be discontinued after the operation, and one of them [613a] does not even advocate refrigeration before application of a tourniquet. This seems reasonable, as the application of a broad tourniquet is not particularly painful. [ED. NOTE.—I suggest that those who are interested try it on themselves to note how relatively painless it is.] Use of a properly arranged rubber sheet on a bed which is slightly raised at one end is recommended instead of the cumbersome ice box in an article by Glasser and Mersheimer,[613a] who make some other practical suggestions. They see no advantage in using iced instruments. [ED. NOTE.—I feel that this is the best article on a practical technic that has appeared, and I urge the surgeon who is considering the use of refrigeration to read it.]

For patients who are debilitated by a gangrenous extremity, Haley [614] recommends elimination of the circulation in the involved extremity by

606. Pouliot, A.: Anaesthesia by Local Refrigeration in Case of Amputation for Gangrene of Lower Extremity, Union méd. du Canada **72**:408-410 (April) 1943.

607. Kennedy, J. A.: Technic and Device for Application of Ice Anesthesia for Amputation of Extremities, U. S. Nav. M. Bull. **41**:226-230 (Jan.) 1943.

608. Allen, F. M., and Crossman, L. W.: Refrigeration in Amputations for Gangrene, Tr. A. Am. Physicians **57**:320-325, 1942.

609. Doane, J. C.: Proof of Practicability of Refrigeration Anaesthesia, Mod. Hosp. **60**:64-65 (May) 1943.

610. Dziob, J. M., and Brown, R. K.: Reduced Temperature Anaesthesia for Surgery of Trauma, Indust. Med. **12**:79-80 (Feb.) 1943.

611. Johnson, M. D.: Experience in St. Louis with Refrigeration Anaesthesia, Mod. Hosp. **60**:65 (May) 1943.

612. Nixon, E. A.: Amputation Anaesthesia by Freezing, Northwest Med. **42**:131-133 (May) 1943.

613. (*a*) Glasser, S. T., and Mersheimer, W. L.: Refrigeration Anaesthesia of Extremities, Am. J. Surg. **62**:231-234 (Nov.) 1943. (*b*) Stevenson, J. A. F.: Reduced Temperature in Surgery, McGill M. J. **12**: 36-39 (Feb.) 1943.

614. Haley, E. R.: Arteriosclerotic Gangrene, Arch. Surg. **46**:518-524 (April) 1943.

application of a tourniquet just below the knee after a half-hour's chilling. The leg distal to this point is then refrigerated for the three or even four days necessary to bring the patient to an optimum condition for amputation. Eight hours before amputation the leg is chilled with chipped ice to the upper third of the thigh, and a half-hour later a second tourniquet is applied 1 inch (2.5 cm.) or so distal to the top of the chilled area. A drawing of the simple but apparently efficient ice box accompanies the article. The management of 4 typical cases is presented in detail.

Evidently stimulated by the success of the use of cold in amputations, two authors discuss the value of cold as a therapeutic agent to relieve pain. Rupp [615] recommends its use for compound fractures, gunshot wounds, crushing injuries and severe infections such as those due to the gas bacillus and suggests its use in military surgical procedures, even in the field, in view of the development of an efficient 200 pound (90.7 Kg.) refrigeration unit. Krieg [616] calls attention to the use of cold as heat is ordinarily used to relieve pain, particularly in combating postoperative pain. He states that in addition to relief from pain there seems to be diminution in the development of complications.

Muirhead, Kregel and Hill [617] report an interesting series of experiments on dogs in which the value of plasma in addition to the amputation of frozen extremities is demonstrated. In a group of 10 dogs from which the limb was removed three and a half hours after freezing, 8 died of shock. In another group, in which replacement of plasma was the only treatment used, all 10 died, while in a third group, in which replacement of plasma was used with amputation, all 10 lived. This article demonstrates the need of adequate surgical operation in addition to replacement of plasma.

The danger of using a tourniquet on an injured extremity is noted by Blalock [618] in experiments on dogs. He found that refrigeration of ischemic extremities during the time the tourniquet is applied definitely minimizes the damage. [ED. NOTE.—Here is another proof of the value of cold in saving tissue by reducing its metabolic requirements.]

615. Rupp, N. H.: Modern Concepts of Refrigeration Anaesthesia, Anesth. & Analg. **22**:46-51 (Jan.-Feb.) 1943.

616. Krieg, E. G.: Control of Postoperative Pain, Am. J. Surg. **62**:114-116 (Oct.) 1943.

617. Muirhead, E. E.; Kregel, L. A., and Hill, J. M.: Therapy of Shock in Experimental Animals, Arch. Surg. **47**:258-282 (Sept.) 1943.

618. Blalock, A.: Effects of Lowering Temperature of Injured Extremity to Which a Tourniquet Has Been Applied, Arch. Surg. **46**:167-170 (Feb.) 1943.

The value of pressure dressings, such as are applied to burns, to severely frozen limbs of dogs is shown by a series of experiments performed by Fell and Hanselman.[619] They give further evidence of the value of immobilization in addition to the value of circulatory support together with protection of superficial structures.

The Callander amputation with the Pearl modification is discussed by Grodinsky,[620] who feels that the flaps of skin are too long and the bed of the patella can be too easily misplaced. He advises against the use of a drain and against the dressing of the wound before seventy-two hours.

The old argument for and against end-bearing stumps is discussed again by Harris,[621] who, with much evidence to substantiate his contentions, upholds the Canadian opinion relative to the value of end-bearing stumps. He compares the favorable results of 130 Stokes-Gritti amputations with the results of 233 amputations through the thigh and the satisfactory outcome of 60 Syme amputations with the outcome of twice as many amputations below the knee. [ED. NOTE.—In spite of these results, one of us feels that for the occasional amputator non-weight-bearing stumps are to be recommended, as the patients and the manufacturers of limbs have least trouble with these. The added skill required to produce a satisfactory end-bearing stump is too great for the procedure to be popular with the average surgeon. The makers of limbs also are able to make better fitting limbs for the non-weight-bearing stumps, at least in the United States. However, my choice would be, if necessary, an end-bearing stump, but it is certain that I should go to a surgeon like Harris, who is enthusiastic about them. It is an excellent article, which should be read by even the occasional amputator.]

Another experienced Canadian amputator, LeMesurier,[622] reviews once more, in an excellent article, most of the important points on amputations needing emphasis, including controversial subjects such as the treatment of nerve endings, the value of end-bearing stumps and the use of temporary limbs.

Pearl and Misrack [623] discuss anew the value

619. Fell, E. H., and Hanselman, R.: Prevention of Shock and Death by Immediate Application of a Pressure Dressing, Ann. Surg. **117**:686-691 (May) 1943.

620. Grodinsky, M.: Modification of Callander Amputation, Surg., Gynec. & Obst. **76**:337-340 (March) 1943.

621. Harris, R. I.: Amputation-Stumps, Wisconsin M. J. **41**:1086-1090 (Dec.) 1942.

622. LeMesurier, A. B.: Amputation Stumps, J. Bone & Joint Surg. **25**:566-575 (July) 1943.

623. Pearl, F., and Misrack, M.: Atraumatic Amputation Through Lower Thigh, Surg., Gynec. & Obst. **77**:354-359 (Oct.) 1943.

of the Pearl modification of the Callander operation, particularly as regards its use in peripheral vascular disease, but no new points are brought out. They simply emphasize the so-called atraumatic technic, which avoids cutting through muscle tissue.

Bickel and Ghormley[624] emphasize the value of amputations below the knee in occlusive arterial disease and do not feel that they are as hazardous as commonly believed. They admit that good surgical judgment, which really means experience, is necessary, and here again it is brought out for the occasional amputator who has to make up his own mind that an amputation below the knee is a much more radical procedure than a classic amputation through the thigh. In other words, this is a paper for a surgeon well experienced in occlusive vascular disease and amputations. Of 110 cases in which amputation below the knee was done at the Mayo Clinic in the last eleven and one-half years for this condition, in only 20 was reamputation above the knee found necessary.

Breed and Mulholland[625] have written a comprehensive paper on amputations, which includes some controversial points but which brings out nothing particularly new. Refrigeration anesthesia, prevention of thrombosis and local instillation of sulfonamide drugs are discussed.

An excellent paper which urges delay in amputation for extensive organic arterial occlusion, pending improvement of the patient's condition, has been written by Theis.[626] He also calls attention to the futility of minor amputations.

Amputations for gas gangrene are discussed in an article in the *Bulletin of War Medicine*,[627] and the following important points are stressed: 1. The spread of infection in muscle is longitudinal and not from group to group, so that a longer stump is made possible by the removal of individual infected muscle tissue above the point of section of the bone. 2. Flaps of skin may be fashioned with actual crepitus present but should not be sutured. 3. Changes in the color of the skin do not indicate the extent of the subjacent infection. 4. Guillotine operations are satisfactory only if immediate traction of the skin is possible.

624. Bickel, W. H., and Ghormley, R. K.: Amputations Below the Knee in Occlusive Arterial Disease, S. Clin. North America **23**:982-994 (Aug.) 1943.

625. Breed, E. S., and Mulholland, J. H.: Amputation in Relation to Extremity Injuries, S. Clin. North America **23**:534-555 (April) 1943.

626. Theis, F. V.: Amputation for Advanced Arterial Disease, Surg., Gynec. & Obst. **76**:35-40 (Jan.) 1943.

627. Amputations for Gas Gangrene, abstracted, Bull. War Med. **3**:492 (May) 1943.

Two articles on transiliac amputation have been abstracted but do not have enough new material in them to warrant separate comment, and the reader particularly interested is referred to the original articles.[628]

Shimberg,[629] writing from the headquarters of the Veterans' Administration, discusses in a rather extensive article a program for the amputee from the time of his amputation to his complete rehabilitation, showing how the Veterans' Bureau is planning to take care of the handicapped military personnel. It has evidently been written as a guide or blue print, particularly for centers where amputations are performed.

Two articles,[630] one of them by Kessler, have appeared during 1943 on kineplastic amputation of the forearm, showing that some surgeons are still doing this highly technical procedure, which should be reserved for those who do this operation routinely.

Maynard[631] discribes disarticulation of a hip joint in which instead of the conventional ligation of the femoral artery in the groin at the start a double subcutaneous tourniquet is pulled through a stab wound on the inner aspect of the thigh from a trochanteric wound an inch (2.5 cm.) below the groin. One part of the rubber tubing is brought around in front to include the femoral vessels, and the other half is passed around the back to surround the gluteal vessels. After the ends of the tube are fastened together tight enough with clamps, the amputation is done in the usual manner, the large vessels being picked up and ligated as they are encountered. [ED. NOTE.—I, after having done several disarticulations of the hip joint in the conventional manner, i. e. by ligating the femoral artery at the start, see no particular advantage in Maynard's method, but it is mentioned here as it was thought that its novelty might appeal to others.]

An important discussion on amputations in children has been written by vom Saal,[632] who recommends epiphysial fusion to avoid the protrusion of bone from the end of the stump.

628. King, D., and Steelquist, J.: Hip, Tumors, Transiliac Amputation, J. Bone & Joint Surg. **25**:351-367 (April) 1943. Fernández Fierro, D.: Interiliosacropubic Disarticulation, J. Internat. Coll. Surgeons **6**:368-374 (July-Aug.) 1943.

629. Shimberg, M.: What Shall Be Done for the Amputé? M. Bull. Vet. Admin. **19**:428-432 (April) 1943.

630. Adams, J. D.: Kineplastic Amputation of Forearm, New England J. Med. **229**:466-468 (Sept. 16) 1943. Kessler, H. H.: Cineplastic Operation in Rehabilitation of Amputation Cases, Mil. Surgeon **93**:281-285 (Sept.) 1943.

631. Maynard, R. L.: Hip-Joint Disarticulations, Tr. New England S. Soc. **24**:248-256, 1941.

632. vom Saal, F.: Amputations in Children, Surg., Gynec. & Obst. **76**:709-710 (June) 1943.

[Ed. Note.—I have not had much experience along this line, but in the few cases that have come under my observation I have not had this complication and wonder if the ends of the bone were properly covered at the start. I recently saw two stumps, two and four years after amputation, that were giving no trouble.]

Apparatus.—The description of a new portable, dismountable pelvic support was published in Brazil [633] in 1942. The device has, as far as can be noted, no particular advantage over those of a similar nature which have already been devised to hold a pelvis with ease while plaster bandages are applied.

The use of wood instead of metal in the making of a Bohler-Braun frame, designed with certain modifications, is recommended by Nickerson.[634] One wonders during these days of metal shortage why more apparatus, even Thomas splints, have not been made of wood, in spite of its lack of strength and durability.

Hauser and Martin [635] have devised a simplified fracture table of wood, which apparently has served well. Detailed drawings are shown. A few bolts and a shelf bracket are the only metal fittings used. The table can be easily assembled at any station hospital with scrap lumber.

Also in view of the scarcity of metals Dudgeon and Rike [636] have devised an inexpensive portable wood fracture table. Any one who is contemplating making one should certainly peruse these two articles, as they are both well illustrated, and in Dudgeon and Rike's article even the size and the quantity of lumber are given.

Appreciating the drawbacks of the permanently applied Bohler "walking iron" cast, Lawson [637] recommends a detachable wooden sole, or sabot, as he calls it, which can be removed at night and which has many other advantages. It is attached like a roller skate except that straps are used both in front and in back. [Ed. Note.—I recall seeing just such an arrangement in Putte's clinic in 1935, which I adopted and have been using ever since, especially as a lift to discourage weight bearing on an extremity that needs protection (coxa plana).]

An improvement even on this sabot has been suggested by Stamm,[638] who attaches a steel runner to the bottom of the wooden shoe in order that some of the thrust in walking may be taken up. This would be particularly suitable for building up a short leg. [Ed. Note.—I distinctly recall such an apparatus put out commercially.]

Still another "walking iron," almost identical to Putte's, has been constructed entirely of wood by Clark,[639] a Britisher, and it straps on. He calls it rather appropriately a "rocker."

With the discrediting of Sister Kenny's policy of discouraging accurate evaluation of muscular strength, a simple muscle-testing board devised by Brown and Thompson [640] is worth noting and looking into by those who are interested. It is portable and can be used both in bed by folding the short legs or in the usual way, as desired.

A skeletal support applied to the ilium just behind the anterior superior spine on both sides, to prevent decubitus in paraplegia, is described by Westhues [641] of Germany; it is well worth considering for some patients with transverse lesions of the spinal cord, who are so difficult to handle. To simplify the method, the author also suggests a special pelvic caliper. He states that the apparatus has been left in place for as long as fifteen weeks without injury to the patient. This apparatus will be appreciated by many who have too often felt the need of such a support.

An improvement on the simple forearm crutch has been devised by another German,[642] in which the forearm stabilizer is a full rather than a half ring; it is on a swivel and encircles the arm just below the elbow. The hand grip is made to fit the palm a little better and simulates more a pistol grip to give better control. The author claims that falls from the loss of control of one crutch are almost unknown. [Ed. Note.—It is felt that this special attention to crutches indicates a dearth of artificial limbs in Germany.]

An extension ambulatory cervical splint which functions as a Thomas ring splint on the leg has

633. de Araujo, A.: Portable and Dismountable Pelvis Support, Rev. brasil. de ortop. e traumatol. **3**: 271-274 (July-Aug.) 1942.

634. Nickerson, S. H.: Wooden Splint to Be Used in Skeletal Traction, Bull. U. S. Army M. Dept., July 1943, no. 68, pp. 203-211.

635. Hauser, C. U., and Martin, W. F.: Simplified Fracture Table of All Wood Construction, Mil. Surgeon **93**:313-317 (Sept.) 1943.

636. Dudgeon, H., Jr., and Rike, B. J.: An Inexpensive Portable Fracture Table, J. Bone & Joint Surg. **25**:469-472 (April) 1943.

637. Lawson, J.: Device to Replace Walking Iron in Plaster Cases, J. Roy. Army M. Corps **81**:39-40 (July) 1943.

638. Stamm, T. T.: New Walking Iron for Short Leg Plasters, Brit. M. J. **2**:13 (July 3) 1943.

639. Clark, C. D.: Walking "Iron" for Leg Plasters, Brit. M. J. **2**:364 (Sept. 18) 1943.

640. Brown, M. E., and Thompson, R. L.: Muscle Testing Board, Physiotherapy Rev. **23**:155-156 (July-Aug.) 1943.

641. Westhues, H.: Half Suspension of Pelvis, abstracted, Bull. War Med. **3**:440-441 (April) 1943.

642. Stocksmeier, H.: Ring Crutch, Deut. Militarärzt **7**:460-462 (July) 1942; abstracted, Bull. War Med. **3**:387 (March) 1943.

been devised by Hook and Mazet [643] for application to fractures of the cervical portion of the spine when Cruchfield tongs for skeletal traction are employed. There are various obvious advantages, the particular one being that the vertical position of the body can be maintained at least part of the time and the patient therefore is more mobile; mobility is especially desirable in military combat areas.

Bisnoff [644] has devised an apparatus which facilitates the care of extensive injuries to the jaw. The equipment is too complicated for description here, and the interested reader is referred to the original article. The outstanding advantage of the appliance is that it eliminates the need for specially constructed plaster head casts as supports for traction wires.

The useful anvil retractor of Blount [645] for trochanteric osteotomy, which was shown in his excellent exhibit at the meeting of the American Academy of Orthopaedic Surgeons in 1943 in Chicago, has been recorded in orthopedic literature and is worthy of mention. [ED. NOTE.—I have found after repeated use that the apparent excessive pressure on the tissues on the dorsum of the thigh does no harm, and it certainly does receive a great deal of the pounding during an osteotomy, which otherwise would be transmitted completely to the joint.]

Written for nurses but meriting the attention of surgeons, Calderwood's [646] article on Russell traction can be better understood than the original article, which appeared over twenty years ago.

An ingenious and inexpensive apparatus, all in one piece, used as a combined adhesive tape "spreader" and preventer of foot drop has been devised by Baker and Reed.[647] This device, while it allows active motion of the ankle and prevents foot drop, is an efficient "spreader" when traction with adhesive tape is employed.

The principle of the so-called well leg traction for trochanteric fractures, which was originally devised by Dr. Hoke, has been incorporated in an apparatus for above the knee by Stein and Lewis,[648] in order that motion in the knee can remain unrestricted. Single cross traction pins are drilled through both femurs an inch (2.5 cm.) above the condyles, which are immobilized in plaster casts, with a turnbuckle placed diagonally between the casts as a control. For those who do not wish to immobilize the knees, this equipment should be considered.

A transparent splint made of a substance resembling lucite (a polymer of the acrylic ester group of artificial resins) is described by a Britisher.[649] It is similar to the splint experimented with but without success by the I. E. du Pont de Nemours Company. Its drawback is that the material has to be heated so high that a mold of the extremity has to be made rather than the splints being shaped to the part directly. This detracts seriously from its usefulness.

For orthopedic nurses particularly interested in restraint equipment for frames, Warren [650] has written a detailed, well illustrated paper giving patterns for various types of apparatus, such as Bradford frames and chairs. This article should be remembered when present restraint apparatus seems inadequate.

Another article by McGoey [651] along the same line, for reference particularly, is a description of a "T" binder, called a pelvic binder, simply a draping equipment for clinical work, which interferes a minimum amount with motion and observation. For persons not satisfied with their present method of draping, this article is recommended.

For the surgeon wishing to bring his Zander apparatus up to date, an article by Lanckenau [652] is recommended. In it she describes a standard metal unit suspension frame, which in itself is a portable gymnasium. The advantages of modern suspension exercise as compared with the older Swedish remedial exercise are enumerated. Four figures are a help for understanding this rather complicated piece of equipment, which, however, takes up much less room than the old equipment, an important advantage when office floor space is at such a premium.

643. Hook, F. R., and Mazet, R., Jr.: Ambulatory Traction Device for the Treatment of Fractures of the Cervical Spine, U. S. Nav. M. Bull. **41**:207-213 (Jan.) 1943.

644. Bisnoff, H. L.: Fractures of the Jaws: External Traction Appliance, Am. J. Orthodontics (Oral Surg. Sect.) **29**:96-101 (Feb.) 1943.

645. Blount, W. P.: The Anvil-Retractor, J. Bone & Joint Surg. **25**:208-210 (Jan.) 1943.

646. Calderwood, C.: Russell Traction, Am. J. Nursing **43**:464-469 (May) 1943.

647. Baker, L. D., and Reed, F. J.: Self Adjusting Foot Piece for Preventing or Correcting Equinus Deformity When Traction Is Applied to a Lower Extremity, J. Bone & Joint Surg. **25**:680-682 (July) 1943.

648. Stein, I., and Lewis, R. M.: Well Thigh Traction in the Treatment of Intertrochanteric Fractures, Am. J. Surg. **59**:509-512 (March) 1943.

649. MacGowan, T. J. B. A.: Plastic Splints, Lancet **1**:805-806 (June 26) 1943.

650. Warren, O. E.: Orthopedic Restraint, Am. J. Nursing **43**:831-832 (Sept.) 1943.

651. McGoey, P. F.: Pelvic Binder, Brit. M. J. **1**:667 (May 29) 1943.

652. Lanckenau, N. I.: Rehabilitation by Modern Methods of Exercise, Brit. J. Phys. Med. **6**:12-15 (Jan.-Feb.) 1943.

An instrument for opening the jaws has been devised by Hallam,[653] which is obviously far superior to the usual racheted mouth gag; it exerts a force on many teeth rather than on one or two above and below. The only apparent difficulty is in getting it into mouths that are closed or almost closed, as it is evidently a more bulky apparatus than the usual screw or gag.

Brenner[654] describes a traction apparatus similar to but possibly less cumbersome than the Soutter distraction equipment, which appeared many years ago. It is particularly applicable to the lower part of the leg rather than to the upper extremity, to which the Soutter equipment is more adaptable. It is, its originator states, particularly suitable for fluoroscopic work.

Barnard[655] has devised a special surgical table top which is arranged to facilitate the taking of direct lateral roentgenograms of the hip. For the anteroposterior view the usual tunnel is employed, into which the cassette can be slid. An indentation in the side of the 2 inch (5 cm.) thick table top at the level of the trochanter permits the cassette, which is covered with a sterile drape, to be slipped in vertically, so that a lateral roentgenogram can be taken without moving the hip. The article is well illustrated.

Technic.—New Surgical Instruments: A foreign body finder, or "diviner," for locating metallic objects in wounds, which functions on an electrical principle, has been devised by Moorhead.[656] Its specific advantages are (1) portability (about the size of a small radio) and adaptability to any electrical source; (2) ability to be used as an accessory to fluoroscopic and roentgenographic examination or without them; (3) ability to be used within a wound; (4) responsiveness to nonmagnetic as well as to iron or steel objects; (5) ease and certainty of application. It was first used in Honolulu after the attack on Pearl Harbor, when twenty-one fragments were removed on two successive days.

A self-locking retractor, or better a spreader, for arthrodesis is described by Castillo Odena,[657] which is devised particularly for the subastragalar joint but is claimed to be useful in exposing cartilages of the knee, although the translator does not mention cartilages of the knee joint specifically. [Ed. Note.—It is regretted that further information about this instrument is not available, as the report was written in Spanish and appeared in a journal which was not accessible to me.]

A specially designed bone punch for centering plate screw holes through bone is reported by Capener,[658] which allows the proper centering of all the drill holes beneath a plate evenly to give it the greatest strength possible.

Adams,[659] a London surgeon, has devised another instrument for determining the depth of a screw hole in bone so that a screw of proper length can be selected. [Ed. Note.—Many of these instruments have appeared, but one wonders why a simple crochet hook is not practically as good as a special instrument or even an intravenous needle of sufficient length and with the end turned enough to catch the edge of the bone at the distal end of the hole.]

Mitchell,[660] another Britisher, describes a knife devised to facilitate the removal of cartilages in the knee; it is similar to Lowe and Breck's knife, which was described six years ago. [Ed. Note.—I have tried with little success to use this knife; it seems too large for most knees.]

Another expansion reamer for the acetabulum has been designed by Kleinberg,[661] who claims that (1) it is light in weight but strong; (2) it is easily adjustable, and (3) it has a large handle. For those who are dissatisfied with their present reamer, it is suggested that they examine this one.

Basom and Breck[662] have written a paper advocating the use of a commercial subcaliber electric drill geared down from the usual high speed. [Ed. Note.—It is felt that its only advantage is price, as it is feared that a cheap commercial drill could not stand up under constant use, particularly if it is geared down to a speed at which the bearings would be strained by the resultant increased power, for which housing, etc., are not designed. For occasional use, such as drilling in pins, it might be all right, but it would be more likely to fail at a crucial time and be more expensive in the long run. For an emergency it would be useful, but

653. Hallam, J. W.: A Gag for Dysfunction of Temporo-Mandibular Joint Following Mandibular Injury, Brit. M. J. **1**:569 (May 8) 1943.

654. Brenner, F. T.: New Mechanical Fracture Spreader, Am. J. Surg. **59**:141-142 (Jan.) 1943.

655. Barnard, V. L.: New Surgical Table Top and Cassette Holder for Surgical Roentgenographic Examination of the Hip, Radiology **40**:599-602 (June) 1943.

656. Moorhead, J. J.: Foreign Body Finder: The Locator, J. A. M. A. **121**:123-125 (Jan. 9) 1943.

657. Castillo Odena, I.: Self-Locking Retractor for Arthrodesis, Bol. y trab., Soc. argent. de cirujanos **4**: 470-471, 1943.

658. Capener, N.: Punch for Use in Plating Fractures, Lancet **2**:415 (Oct. 2) 1943.

659. Adams, J. C.: Screw Length in Bone Grafting, Lancet **2**:415 (Oct. 2) 1943.

660. Mitchell, A.: Meniscotomy Knife, Lancet **1**:528 (April 24) 1943.

661. Kleinberg, S.: Expansion Reamer, Ann. Surg. **116**:957-959 (Dec.) 1942.

662. Basom, W. C., and Breck, L. W.: Inexpensive Electric Drill, Saw and Kirschner Wire Drill Guide, Am. J. Surg. **60**:151-153 (April) 1943.

for routine use a light weight commercial motor, even altered as suggested, would be far from satisfactory.]

One new advantage of vitallium is cited by an Englishman, Vere-Hodge,[663] who states that its nonmagnetic qualities make it particularly suitable for members of the British Royal Air Force, as compasses in the airplane would not be influenced if a pilot had a nonmagnetic plate in his arm.

Sutherland and Rowe[664] are using metal shelves for the repair of subluxated hips instead of bone, citing however only 3 operations. Two operations came out well, although the shelf seemed a little high in the roentgenograms. One plate was taken out because of sepsis. Walking was permitted four weeks after the operation, which seems to be far too early. Four more operations had been done since the original paper was written, but they had been done too recently to report the results. [ED. NOTE.—I feel that more experimental work should be done on this procedure before it is generally advocated.]

Another article describes a large vitallium cast for the upper quarter of the femur, approximating its normal shape, which was fitted over the shaft after the proximal end had been excised because of a neoplasm. In spite of serious operative difficulties, it functioned well, and the patient died several years later of a heart attack. [ED. NOTE.—This report must describe the largest piece of vitallium ever used and serves as another demonstration of the tolerance of tissue for this inert material. Much credit must be given to the authors[665] for this ingenious piece of work.]

The use of skeletal traction in correcting various severe deformities of the foot is discussed by Morris.[666] While distraction might have been a better term, he has used a positive corrective device that is far superior to plaster casts, which depend for their success on tolerance of the skin to pressure and which are more complicated. [ED. NOTE.—Some deformities need the tremendous force which is available with this method for correction, but one wonders if in most instances the actual sacrifice of bone to obtain the desired correction of the foot might not be the better method.]

Another author[667] cites the advantage of lucite caps in arthroplasty of the hip, because of their radiolucency and minimal irritability to the tissues. Their cheapness is also mentioned. Their use must still be considered in the experimental stage, and further reports will be looked forward to. One views with some concern, however, the long-lasting reaction to the constant chronic irritability of vitallium.

Thompson,[668] in discussing osteotomy for the correction of angular disalinements, calls attention to the advantages of the telescoping V osteotomy in areas where the bone is conoid, such as the femoral trochanteric region, the distal femoral shaft region and the proximal tibial shaft region. [ED. NOTE.—His arguments are reasonable, but when length is an important item the use of transverse osteotomy with the interposition of a wedge of bone obtained from nearly exposed sources appears more logical.]

Noting the ease with which the proximal portion of the sciatic nerve, which is well into the sciatic notch, was exposed through a posterior gluteal approach when they were looking for a foreign body, Naffziger and Norcross[669] have written a paper extolling it as a rational procedure in exposing the posterior aspect of the hip joint and the sciatic nerve before it enters the pelvis. The following advantages are cited: (1) ease of approach; (2) excellent exposure of the region; (3) no severing of important structures, and (4) facilitation of search for foreign bodies in this region.

Taking into account the torsion of the achilles tendon in its nonmuscular portion, White[670] has directed his fractional subcutaneous transverse tenotomy cuts so as to sever all the fibers at two levels, as one would cut the larger strands of a rope at different levels to sever it. He accounts for the twist by its embryologic development.

As a source of nerve grafts Lam[671] has urged the removal of all nerve trunks from amputated limbs when suitable, in order to avoid the

663. Vere-Hodge, N.: Metallic Internal Fixation of Fractures in Air-Crew Cases, Brit. M. J. **2**:419-420 (Oct. 2) 1943.

664. Sutherland, R., and Rowe, M. J., Jr.: Metal Shelf for Hip Dislocation, Am. J. Surg. **62**:206-210 (Nov.) 1943.

665. Moore, A. T., and Bohlman, H. R.: Metal Hip Joint: A Case Report, J. Bone & Joint Surg. **25**:688-692 (July) 1943.

666. Morris, H. H.: Skeletal Traction as a Method of Treatment for Certain Foot Deformities, Arch. Surg. **46**:736-742 (May) 1943.

667. Burman, M. S.: Plastic Materials in Medicine, Am. J. Surg. **62**:124-125 (Oct.) 1943.

668. Thompson, V. P.: Telescoping V Osteotomy, Arch. Surg. **46**:772-779 (May) 1943.

669. Naffziger, H. C., and Norcross, N. C.: Surgical Approach to Lesions of Upper Sciatic Nerve and the Posterior Aspect of the Hip Joint, Surgery **12**:929-932 (Dec.) 1942.

670. White, J. W.: Torsion of the Achillis Tendon: Its Surgical Significance, Arch. Surg. **46**:784-787 (May) 1943.

671. Lam, C. R.: Amputated Limbs as Source for Nerve Grafts, J. A. M. A. **123**:1067 (Dec. 18) 1943.

"begging" of material from pathologists and bereaved persons.

A transverse screw of suitable dimensions through the base of a securely placed Smith-Petersen nail in intertrochanteric fractures is advocated by Thatcher [672] when lack of extensive comminution allows it. The article is illustrated and describes 22 fractures which have been treated this way successfully. The chief advantages are the ease of instillation and later removal if necessary as well as minimum exposure of tissue. [Ed. Note.—The chief disadvantage from my point of view is that complete immobilization is not obtained in the anteroposterior plane. He utilizes a 3/16 inch (0.5 cm.) pin but he agrees that the screw is better for the purpose except for the fact that it is more difficult to obtain.

Pitkin [673] describes a rather complicated surgical technic for bracing the lower part of the back and the sacroiliac joints. He has used it on 53 patients in twelve years. He employs a transverse tibial graft running from one iliac wing to the other immediately behind the sacrum and just distal to the lumbosacral interspace. Beneath this are placed paraspinous grafts bridging the lumbosacral space and resting on the denuded laminas. He reports 1 operative mortality, and one wonders if the results obtained justify the severity of the procedure. The article would have been much easier to understand if there had been some illustrations or roentgenograms. He reports a high degree of success; all patients returned to their former or equivalent occupations, even the 1 who lost her grafts through infection.

Hatt [674] reports success in 44 cases of arthrodesis of the knee or ankle by the central graft; 23 cases were instances of arthrodesis of the ankle in children in whom no serious disturbance in growth had occurred. Nothing was mentioned relative to the subastragalar joint, which must have been severely injured when the graft was driven up through the os calcis and the astragalus and into the tibia. In cases in which involvement is so severe as to require this operation, the persistence of subastragalar motion is of little importance and the amount of damage sustained is therefore of small consequence; hence it may be assumed that arthrodesis occurs in these cases as well. [Ed. Note.—In any event, I feel that there is justification for considering this even in a child to be a satisfactory method for arthrodesis of both an ankle and a knee.]

Girard [675] urges transplanting the hamstring muscles to the symphysis pubis in cases of scoliosis in the presence of pelvic obliquity, if it is certain that they are strong enough to make the operation worth while. The operation also tends to increase the power of the adductor muscles. When the operation is done care must be taken not to injure the obturator nerve, which is the chief nerve supply for the adductor muscles, or the small nerve branches.

An excellent discussion has been published by Abbott and Gill [676] on the approaches to the epiphysial cartilages of the knee and ankle joints for epiphysial–diaphysial fusion. It should be read by all who are contemplating this valuable procedure.

Townsend and Gilfillan [677] have devised a longitudinally channelized stainless steel bone plate with oval slots for screw holes. The channeling gives it extra strength in addition to permitting when necessary one plate to be "nested" over the other so that its length may be extended. It is flexible enough to be molded, and the oval screw holes simplify the introduction of screws. The plate can be bent and even cut at the operating table as desired. [Ed. Note.—Reports on the success of its use will be looked forward to. It is already on the market.]

The problem of lengthening a leg is again discussed in detail, this time by Brockway,[678] who recites his experiences over many years. He reports a formidable series of 109 cases in which the leg was lengthened below the knee and states that shortening of the leg above the knee and operations to arrest the growth of the epiphysis are now more popular. He states that the chief disadvantage of the shortening procedure is that the height is decreased. [Ed. Note.—I have had some experience with this problem and should

672. Thatcher, H. H.: Internal Fixation Device for Treatment of Intertrochanteric Fractures of the Femur, Am. J. Surg. **60**:44-49 (April) 1943.

673. Pitkin, H. C.: Internal Brace for Low Part of the Back, Arch. Surg. **46**:755-758 (May) 1943.

674. Hatt, R. N.: Central Bone Graft in Joint Arthrodesis, Arch. Surg. **46**:664-665 (May) 1943.

675. Girard, P. M.: Paralytic Pelvic Obliquity: Transplantation of Origin of Hamstring Muscles to Symphysis Pubis, J. Bone & Joint Surg. **25**:169-176 (Jan.) 1943.

676. Abbott, L. C., and Gill, G. G.: Surgical Approaches to Epiphysial Cartilages of the Knee and Ankle Joints, Arch. Surg. **46**:591-597 (May) 1943.

677. Townsend, K., and Gilfillan, C.: Bone Plates: A New Type, California & West. Med. **58**:332-334 (June) 1943.

678. Brockway, A.: Leg Lengthening Operation: Its Present Status, California & West. Med. **58**:11-13 (Jan.) 1943.

like to call attention to the fact that reducing the height of a person increases his general stability, as it lowers his center of gravity. Reduced height is most advantageous in the long run in these cases, a majority of which are instances of poliomyelitis, in which increased general stability is to be desired.] In Brockway's cases in which the leg was lengthened he considered the results extremely good in 65 per cent, good in 22 per cent and poor in 13 per cent. He wisely states that the lengthening procedure is never without some hazard.

XIX. RESEARCH

PREPARED BY A. STEINDLER, M.D., AND STAFF, IOWA CITY

Barr, Lingley and Gall [679] found the growing epiphysial plate of the albino rat extremely sensitive to roentgen irradiation. They observed the effect of irradiation on one knee joint of albino rats 30, 90 and 160 days old. The resultant changes were studied histologically and roentgenographically. The skin, subcutaneous tissue, muscles, synovia and articular cartilage showed insignificant transitory changes. On the bone marrow irradiation produced depletion of approximately one half or less of the marrow cellular content in the field of irradiation within two to three weeks; the cellular content returned to a normal level in the succeeding two to four weeks.

Doses of 665 to 1,165 r produced moderately severe histologic changes in the epiphysial plate, while doses of 1,335 to 1,800 r caused severe injury, as evidenced by disruption of columns of cartilage cells and destruction of chondrocytes. There was no evidence indicating stimulation, and only inconsequentially was there evidence of regeneration of the epiphysial cartilage. Careful measurements of longitudinal growth of the tibia after irradiation showed that all the doses used (665 to 1,800 r) produced retardation of growth and that the retardation varied roughly proportionately to the amount of irradiation administered. The large doses (1,335 to 1,800 r) caused essentially complete arrest of growth of the treated epiphysis.

This investigation was motivated by the possibility of a practical use for the known radiosensitivity of the epiphysial plate in place of the surgical arrest of growth by epiphysiodesis (Phemister).

Brailsford [680] states that there are variations in the ossification of the bones of the hand, the cause and the frequency of which give rise to difference of opinion. They concur for the most part with the development of the so-called pseudoepiphyses and the true supernumerary epiphyses. The latter are regarded as developments from a separate center of ossification and the former as bony extensions from the diaphysis into its cartilaginous extremity. The author studied 1,000 roentgenograms of the hand of apparently normal infants up to 3 years of age, 100 roentgenograms of congenital malformations of the hand and 193 of different diseases of the hand. Of the 1,000 roentgenograms of the hands of apparently normal infants 89 showed abnormal ossification of the metacarpal bones; in 83 of these, the abnormal development was of the nature of pseudoepiphyses and in 62 it was located at the proximal extremity of the second metacarpal bone. The impression of the author is that separate additional osseous nuclei may develop in the first and second years of life and fuse before the osseous nuclei of the normal epiphysis appear.

Certain conditions retard the growth of the epiphysis; retarded growth is a characteristic feature of hypothyroidism but does not exist with true supernumerary epiphyses or pseudoepiphyses.

In chondro-osteodystrophy, ossification of each epiphysis proceeds from multiple irregular ossific nuclei, but there is no true epiphysis or pseudoepiphysis. Roentgenograms of congenital deformities did not show either true epiphyses or pseudoepiphyses. Craniocleidodysostosis is regarded as a condition in which defective ossification occurs only in those bones which are laid down in membrane, but the author found modifications of the bones of the hand also. He reports the presence of additional epiphyses to the middle and proximal phalanges and dysostosis which often affects only the long bones of the hand and feet. In cases of arachnodactyly true supernumerary epiphyses are seen in the phalanges and metacarpal bones of the long, slender fingers. Extra epiphyses may be seen also in cases of multiple chondromas and achondroplasia.

An attempt was made by Duckworth and Warnock [681] to construct a composite picture of the behavior of calcium and magnesium in man during his development. Requirements of cal-

679. Barr, J. S.; Lingley, J. R., and Gall, E. A.: Effect of Roentgen Irradiation on Epiphysial Growth: Experimental Studies upon Albino Rat, Am. J. Roentgenol. **49**:104-115 (Jan.) 1943.

680. Brailsford, J. F.: Variations in Ossification of Bones of Hand, J. Anat. **77**:170-175 (Jan.) 1943.

681. Duckworth, J., and Warnock, G. M.: Magnesium Requirements of Man in Relation to Calcium Requirements, with Observations on Adequacy of Diets in Common Use, Nutrition Abstr. & Rev. **12**:167-183 (Oct.) 1942.

cium were estimated from data on calcium metabolism for normal children in relation to independent studies of skeletal growth.

An analysis of the data afforded by dietary surveys suggests that the lower income groups, representing 30 per cent of the population, have habitual intakes of magnesium that are either borderline or deficient as judged by requirements; these estimates provide, as far as can be seen, no margin of safety.

Duncan and Blalock [682] performed experiments in which a mechanical press was applied to an extremity for an extended period (fifteen hours). The animals died even though plasma was given intravenously in an amount equal to that lost locally. The same experiment with the pressure applied for only five hours did not always cause death. Hence it is felt that ischemia and anemia over the extended time were responsible for the severity of the shock.

The authors then studied the effects of applying a tourniquet to an extremity after injury to the soft tissues.

Method: A leg of each of 10 large animals was traumatized by blows from a hammer. Then a tourniquet was applied proximal to the damaged area. A leg of each of 10 control animals was also traumatized, but a tourniquet was not used. Control animals were given plasma two hours following the traumatization; test animals were given plasma in five hours, just at the time the tourniquet was removed. Five per cent of the body weight was the amount of plasma given to the control animals and 5 of the test animals. The other 5 test animals were given 9 per cent of their body weight.

Results: Of the control animals, 8 recovered and 2 died. One died in ninety hours; autopsy revealed pneumonia and an abscess of the thigh. The other died on the twenty-fifth day and also had an abscess.

All 10 test animals died within three to thirty-six hours, the average being about fourteen hours.

	Control Group	Test Group
Pulse	Slight rise	Accelerated
Blood pressure	Little alteration	Gradual fall
Plasma creatine	Little alteration	Elevated
Nonprotein nitrogen	Little alteration	Elevated
Urine	Slight reddish discoloration and few erythrocytes	Darker in color, moderate number of erythrocytes and granular casts
Hematocrit reading	Little change	Decline

682. Duncan, G. W., and Blalock, A.: Effects of Application of Tourniquet on General Response to Gross Trauma to an Extremity, Surgery **13**:401-405 (March) 1943.

The authors conclude that the application of a tourniquet to an injured extremity greatly lessens the chances of survival of the animal.

Fell and Hanselman [683] carried out experiments which showed that severe freezing of a dog's extremity results in extensive local swelling, clinical shock and death in most cases.

Ten dogs were anesthetized and the right hindlimb immersed up to the upper third of the thigh in a mixture of solid carbon dioxide and 95 per cent alcohol at —55 C. for twenty minutes. Five dogs received no form of therapy and were allowed to thaw out at room temperature. The other 5 dogs had two or three layers of sheet wadding wrapped around the extremity, over which a plaster encasement was applied above the frozen line.

All 5 untreated dogs acquired clinical shock, with 4 dying in thirteen hours. All of the treated dogs lived, and the maximum increase in the hematocrit reading was only about one-half as great as for the untreated group. One treated dog had its limb amputated in forty-eight hours and recovered. Necrotic limbs developed in the other 4; 2 had their limbs amputated eight and eleven days following freezing and made uneventful recoveries; 1 died nine days after freezing from a second degree infection; the other dog died of peritonitis following disarticulation fourteen days after freezing.

They conclude that immediate application of smooth plaster pressure bandages saved the 5 dogs from shock and death after the hindlimbs had been frozen.

Gardner [684] determined the "breaking strength" of the femurs of 241 mice which had received estrogen or estradiol benzoate plus testosterone propionate under uniform conditions: also determined was the "breaking strength" of the femurs of 162 untreated mice of the same stock. In the untreated mice, the femurs declined in strength as the mice advanced in age and the bones of the females were stronger than those of the males. The most radiopaque femurs showed the greatest resistance to fracture.

In the estrogen-treated mice the breaking strength of the femurs was much greater than in the control animals of the same age. The estrogen-treated male mice had stronger femurs than the estrogen-treated female mice. The

683. Fell, E. H., and Hanselman, R.: Prevention of Shock and Death by Immediate Application of Pressure Dressing to Severely Frozen Limbs of Dogs: Experimental Study, Ann. Surg. **117**:686-691 (May) 1943.

684. Gardner, W. U.: Influence of Sex and Sex Hormones on Breaking Strength of Bones of Mice, Endocrinology **32**:149-160 (Feb.) 1943.

simultaneous injection of testosterone propionate and estrogen prevented the increase in strength observed in mice given estrogen alone. The bones of the female mice given testosterone propionate were much weaker than the bones of the untreated control mice of the same age group.

Reed and Reed [685] begin an article on antirachitic healing by briefly discussing the equipment, the methods and the experimental material. When examined by roentgen diffraction technic, the cortices of the tibias of albino rats show characteristic preferred orientation on the long axis of the bones. The identity of bone salts with apatite was confirmed by the finding of nearly identical powder diffractograms of bone and apatite. It is the authors' opinion that disorientation in rickets bears no direct relation to the ability of bones to resist mechanical stress, since bones of rachitic rats may be restored, but disorientation is not repaired completely in two hundred and seventy-five days with an antirachitic diet.

The authors state that they have not been able to determine as yet whether disorientation has any physiologic significance other than as an indicator of a type of metabolic disturbance.

Schiller, Struck and Reed [686] give a brief discussion of experimental methods and describe apparatus for applying a quantitative breaking test to the bones of rats. The experiments involved 267 animals, and the results indicated that the tibias of rats that had been rachitic and then healed, when compared with those of littermate control rats, showed significant differences in resistance to lateral breaking stress in two of nine series.

Annersten [687] goes further into the chemistry of bone, showing by formulas the chemical process by which the reactions occur. He stresses the importance of p_H of the blood, especially at the site of fracture, and the enzyme contained in tissues by which bone cells are differentiated from mesenchymal tissues. He feels that much work is yet to be done to explain fully all the chemical processes of healing of bone.

685. Reed, C. I., and Reed, B. P.: Attempted Correlation of Mechanical Properties of Bone with Antirachitic Healing and with Molecular Structure as Determined by X-Ray Diffraction Technic, Am. J. Physiol. **138**:34-41 (Dec.) 1942.

686. Schiller, A. A.; Struck, H. C., and Reed, C. I.: Influence of Rickets and of Healing of Rickets on Mechanical Properties of Tibiae of Rats, Am. J. Physiol. **138**:27-33 (Dec.) 1942.

687. Annersten, S.: Alkalization in Fracture Callus, Arch. f. klin. Chir. **203**:122-136, 1942.

Bell and Cuthbertson [688] ran a series of experiments on white rats. They were fed an adequate diet, and certain hormones were given with the diet.

Extract of the anterior lobe of the pituitary gland produced bigger and proportionately stronger bones than those of control animals which had received injections of extract of thymus, but there was no alteration in the breaking stress.

Estradiol dipropionate produced heavier and stronger bones but no change in breaking stress.

The femurs of rats treated with parathyroid extract were longer and heavier than those of either rats treated with estradiol or control rats. The breaking stress remained unchanged.

Thyroid produced a greater change in soft tissue than in mineral matter. The quality of bone remained the same.

Bruce and Kassner [689] used various bones to compute values of bone ash. The percentage of ash in dry fat-free humerus was chosen as the basal value, and the results were evaluated irrespective of sex and the dose of vitamin D given.

When low calcification in rats, as measured by ash content of the humerus, is due to shortage of vitamin D, the femur shows an even lower calcification. When it is due to deficiency of either calcium or phosphorus without a shortage of vitamin D, no difference in calcification is observed. In the femur both the relatively large metaphysis and the extremely low calcification of this part make the ash content of the whole bone lower than that of the humerus when vitamin D is lacking. Sex does not make any difference in the humerus or the femur.

Clavert [690] credits Zondick (1937), Landaner, Gardner and Pfeiffer (1939), in experiments on the pigeon and chicken, and Bensit, Messerschmidt and Grangaud (1941), in experiments on the duck, with having found by regular injections of estradiol dipropionate an estrogenic action similar to that found in female birds. He repeated the experiment on 17 male pigeons and 1 castrated female pigeon.

688. Bell, G. H., and Cuthbertson, D. P.: Effect of Various Hormones on Chemical and Physical Properties of Bone, J. Endocrinol. **33**:302-309 (Aug.) 1943.

689. Bruce, H. M., and Kassner, E. W.: Difference in Calcification Between Humerus and Femur of Young Rats Receiving High Calcium, Low Calcium, and Stock Diets, J. Biochem. **37**:105-109 (April) 1943.

690. Clavert, J.: Osteogenetic Action of Estradiol Dipropionate (Estrogen) in Pigeons, Compt. rend. Soc. de biol. **136**:512-513, 1942.

The daily injection of estradiol during several weeks excites in many bones of the male pigeon intense osteogenesis, which is greater than that in females. It reacts by osteogenesis of a medullary type. Springing always from a preexisting substratum, the bony bridges invade the medullary cavity and then condensate by apposition of bony layers. The medulla preserves its activity. Fat tissue disappears.

Foshee [691] presents a study of regenerative power of fascia lata. Kleinschmidt has demonstrated that normal fascia lata contains three distinct layers, each within its own sheath and the three within a common denser sheath. The middle layer is strongest and runs longitudinally. The inner and outer layers are weaker, and their fibers run transversely at an angle of 90 degrees to those of the middle layer.

Fascia lata regenerates to fill defects left when tissue is removed. In thin, muscular persons the margins of fascia lata approximate to close the vent by rapid and thick formation of fibrous tissue, which is in all probability derived from the inner and outer layers. In obese persons the margins of fascia retract farther and for a short time permit some formation of muscle through the vent, but soon the defect is filled by new fascia lata one-half the thickness of the old fascia lata. This is thought to be the regeneration of the outer and inner layers of the true fascia lata.

When every iota of fascia lata is removed, new fascia lata of from one half to two thirds of the thickness and tensile strength of the previous tissue regenerates to cover the whole area normally covered by fascia lata, and it may well be used again for sutures and transplants as well as for the true purpose of the tissue, that of making a sleeve for muscles and preventing herniation.

Katzenstein, Mylon and Winternitz [692] undertook experiments to find out the effect of injection of thoracic duct fluid collected promptly after the release of tourniquets which had been applied to the hindlegs of dogs. They found that the thoracic duct fluid becomes blood stained after release of the tourniquets and that when this fluid is injected intravenously its effect on blood pressure is variable; but in some cases 7 cc. of fluid may produce a severe and protracted fall in blood pressure, which may cause the death of the animal.

The authors also observed that changes in blood pressure and other signs of shock may follow nothing more than anesthesia induced with pentobarbital sodium. In experimental cases in which narcosis was controlled to avoid vasodepression, injection of thoracic duct fluid from normal dogs had no significant effect while a fall in blood pressure followed in 50 per cent of the animals which received injections of thoracic duct fluid of animals shocked by the tourniquet method.

Segaloff and Cahill [693] studied the changes in the bones in mice treated with estrogen and fed food deficient in vitamin D. They based these experiments on previous investigations made by other authors, who found extensive proliferation of endosteal bone in the femurs of mice treated with estrogen and maintained on adequate diets. The estrogenic agent administered in this study was α estradiol dipropionate, and the duration of treatment was twelve weeks.

Obliteration of the marrow cavity of the femur by endosteal bone and some resorption of pubic bone were observed in a strain of mice fed commercial stock diets and treated with estrogen. Mice of the same strain treated with estrogen and fed a diet deficient in vitamin D supplemented with viosterol showed typical changes in the femur. This result was also obtained in animals fed the same diet unsupplemented with vitamin D. It is concluded, then, that dietary vitamin D did not play a major role in the mechanism of deposition of endosteal bone in the femurs of mice treated with estrogen.

Torda [694] investigated whether or not the presence of androgens, estrogens and some of the hormones of the hypophysis modifies the muscular contraction produced by known chemical agents. Both the sensitivity of striated muscle to acetylcholine and potassium and the activity of choline esterase of brain tissue were investigated in the presence of the previously mentioned hormones. It was found that the sensitivity of the muscle to acetylcholine is somewhat potentiated by chorionic gonadotropin, estrone and estradiol, the corpus luteum hormone, testosterone propionate and the vasopressor and antidiuretic hormone of the posterior

691. Foshee, J. C.: Fascia Lata Regeneration: Preliminary Report, Surgery **14**:554-569 (Oct.) 1943.

692. Katzenstein, R.; Mylon, E., and Winternitz, M. C.: Toxicity of Thoracic Duct Fluid After Release of Tourniquets Applied to Hind Legs of Dogs for Production of Shock, Am. J. Physiol. **139**:307-312 (June) 1943.

693. Segaloff, A., and Cahill, W. M.: Endosteal Bone Deposition in Femurs of Vitamin D-Deficient Mice Treated with Estrogen, Proc. Soc. Exper. Biol. & Med. **54**:162-163 (Oct.) 1943.

694. Torda, C.: Effect of Hormones on Contraction of Striated Muscle and on Choline Esterase Activity, Proc. Soc. Exper. Biol. & Med. **53**:121-125 (June) 1943.

lobe of the hypophysis but not by the oxytocic principle of the posterior lobe of the hypophysis.

The activity of choline esterase is somewhat decreased by chorionic gonadotropin, estrone suspension, progesterone, testosterone propionate and pitressin but not by pitocin.

The sensitivity of the muscle to potassium is potentiated by chorionic gonadotropin, estrone suspension, estradiol, estrone, progestin, progestoral (anhydrohydroxyprogesterone), testosterone propionate, desoxycorticosterone, cholesterol and pitressin but not by pitocin.

A correlation between the threshold of excitability of the effector cells and the presence of these substances was suggested.

Warkany and Schraffenberger [695] describe the appearance of congenital malformations in the offspring of female rats fed a deficient diet composed of yellow cornmeal 76 per cent, wheat gluten 20 per cent, chemically pure calcium carbonate 3 per cent and chemically pure sodium chloride 1 per cent. Sixty international units of vitamin D as viosterol was administered to each female by pipet every tenth day. The malformations could be prevented in the offspring when the maternal diet was supplemented by 2 per cent dried pig liver. The authors used in their experiments a purified diet which contained vitamin B complex but not riboflavin. They obtained congenital malformations in the offspring that were anatomically identical with those obtained with the other diet. The malformations consisted in shortness of the mandible, tibia, fibula, radius and ulna, fusion of the ribs and center of ossification of the sternum, syndactylism, brachydactylism and cleft palate.

Whicher and Watson [696] found that certain hormonal preparations when injected into albino rats apparently produce changes in the phosphatase content of the femur. It was observed that repeated doses of small amounts of parathyroid extract cause a temporary increase of the phosphatase content of the diaphysis without alteration of this enzyme in the epiphysis. Large single doses of the extract cause an increase followed by a decrease of the phosphatase content of the diaphysis while there is only a decrease in the epiphysis. The injection of adrenal cortical extract is followed by a reduction of the phosphatase content in both the diaphysis and the epiphysis. The authors observed in their experiments the effects of the hormones derived from the anterior pituitary gland and concluded that both the thyrotropic hormone and the gonadotropic factor, injected subcutaneously, caused an increase of the phosphatase content of the diaphysis and the epiphysis. The results obtained with pituitary extract purported to contain the growth-stimulating principle were not consistent. In some experiments they produced an increase, in others a decrease and in others no changes whatsoever. Insulin did not cause any modification in the phosphatase content of the bones of the rats, and potassium iodide produced an increase of the phosphatase content of the femurs of albino rats.

Foà [697] reviews the history of studies on innervation of bone marrow, from the first postulation of such in 1700 to the present recent contribution by Rossi.

Rossi described the main nerve trunks which follow the arteries of the bone marrow, both at the center and at the periphery, in the medullary canal. From these trunks are derived loose nets in the endothelial walls of the venous sinuses. Myelinated and unmyelinated fibers are present in about the same number. He also recognized fibers destined for cellular elements of the bone marrow and of the bone itself. These fibers do not follow the blood vessels. Terminal nerve endings were demonstrated to be of several types. There appeared to be a crowding of blood-forming elements around these terminations. The majority of these fibers are myelinated, while the unmyelinated fibers are in close contact with the blood vessels, especially the muscular coat and the endothelium.

Thus, according to Rossi there are two types of nerve fibers of the bone marrow: (*a*) the unmyelinated fibers, which are in close relationship to the muscular coat and endothelium of the blood vessels; (*b*) the myelinated fibers, which seem to be closely related to the blood-forming cells.

Gomori [698] discusses the relationship between the activity of phosphatase and calcification under normal and pathologic conditions, as shown by a new microtechnical method for simultaneous visualization of preformed deposits

695. Warkany, J., and Schraffenberger, E.: Congenital Malformations Induced in Rats by Maternal Nutritional Deficiency: Effects of Purified Diet Lacking Riboflavin, Proc. Soc. Exper. Biol. & Med. **54**:92-94 (Oct.) 1943.

696. Whicher, C. H., and Watson, E. M.: Effects of Thyrotropic Hormone, Gonadotropic Factor, Pituitary Growth Substance and Insulin upon Phosphatase Content of Rat Femurs, Endocrinology **33**:83-86 (Aug.) 1943.

697. Foà, P. P.: Studies on Innervation of Bone Marrow: Anatomy, Univ. Hosp. Bull., Ann Arbor **9**: 9-10 (Feb.) 1943.

698. Gomori, G.: Calcification and Phosphatase, Am. J. Path. **19**:197-209 (March) 1943.

of calcium salts and of sites of phosphatase activity.

Since calcium salts are removed and phosphatase destroyed by decalcification, all material studied was embedded and cut without decalcification. Thus tissues too hard to be sectioned were not studied. The tissue was stained by methods for demonstration of phosphatase, devised for the purpose of simultaneous visualization of preformed deposits of calcium salts and of sites of phosphatase activity.

Observations on normal material and on pathologic material were made. Of the latter, bone tumors tuberculosis and calcification in hyaline cartilage were studied with the phosphatase-staining technic.

Conclusions were that calcification of living or recently necrosed tissues seems invariably to involve activity of phosphatase. On the other hand, calcification of hyaline connective tissue occurs without any action of phosphatase. Acid phosphatase plays no role in calcification.

Henry [699] describes a method of exposing the arched proximal segment of the anterior tibial vessels, which he feels is important because of the fact that most surgeons are unprepared to stop bleeding from the arch by direct exposure. Other methods used for this purpose, such as reflection of the fibula or direct pressure with a tampon, seem unsatisfactory because of the extensiveness of the procedure or the danger to residual blood supply.

With the patient in the prone position, the arch of the tibial vessels is exposed through a posterior and medial incision which extends down between the two heads of the gastrocnemius muscle. Since the arch segment is held fast in front by soft tissue, mobilization is not possible until the arch is mobilized in the anterior compartment of the leg. To accomplish this an anterior incision is made between the fibular head and the tibia, extending deep between the extensor digitorium longus and tibialis anterior muscles. Thus after the arch has been freed anteriorly the entire segment can be brought into view in the posterior part of the wound.

699. Henry, A. K.: Exposure of Arched Segment of Anterior Tibial Vessels, Lancet **1**:141-142 (Jan. 30) 1943.

PREFACE

In the preparation of this review of orthopedic surgery for 1943 the titles of 1,252 articles of orthopedic interest were selected from the *Quarterly Cumulative Index Medicus* for 1943. The number of articles reviewed and presented in this year's "Progress" is 699. This is a smaller number of articles than that selected for previous reviews. The smaller number of articles is due to the decrease in the volume of medical literature since the war commenced. As in the past three years, each editor has selected the articles for his section which he thinks represent the most progress and have the greatest scientific interest. The chairman or Dr. R. B. Raney of the editorial board has reviewed the material prepared for each section and has made certain additions and changes which seemed indicated to standardize to improve the publication as a whole.

On account of the difficulties under which many of the editors have been working, the reviews of some of the sections have been slower in being returned to the chairman of the editorial board, and, as was true last year, it was found impossible to send the whole "Progress" to the ARCHIVES at one time. This has necessitated a slight change in the order of the sections for publication. The preface could not be written until all sections had been submitted. Unfortunately, the section on "Conditions Involving the Hip Joint" was not received in time to be included in the "Progress" for 1943. The articles selected for review in this section will be included in the "Progress" for 1944. In spite of the difficulties encountered in getting reprints, it is believed that the quality of the reviews is up to standard and the publication will prove as valuable to its readers as the "Progress" of previous years.

The members of the editorial board wish to thank again those physicians not members of the American Academy of Orthopaedic Surgeons who have rendered such valuable assistance in the preparation of the material for the various sections. Special thanks are rendered to Dr. Harold H. Kuhn for editing the section on "Conditions Involving the Lower Part of the Back."

The following physicians acted as assistants to members of the editorial board:

Dr. Ghormley: Dr. H. H. Young, Dr. W. H. Bickel, Dr. T. R. Lipscomb, Dr. R. D. Mussey Jr., Dr. J. M. Regan and Dr. F. Padilla.

Dr. Colonna: Dr. David King and Dr. Thomas Gucker.

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Dr. Meyerding: Dr. J. M. Regan, Dr. R. D. Mussey Jr., Dr. J. F. Stotler, Dr. J. J. Hinchey,

Dr. J. H. Remington, Dr. Federico Padilla and Dr. A. R. Pils.

Dr. Hauser: Dr. Robert P. Montgomery.

Both style and editorial comments have again been left to the discretion of the editors, except for a few changes made by the chairman of the editorial board or by Dr. R. B. Raney. It should be stated again, however, as in the preface of the "Progress" of previous years: "If the reader or author of any article does not agree with the editorial comment, the editorial board hopes that he will think of the remark as only one man's impression and as in no way representing the opinion of the entire editorial board."

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KIDNEYS

Anomalies.—Nation [1] states that renal agenesia implies the complete absence of renal tissue. The renal anlage develops in most cases, even in the absence of a ureter, but is usually absorbed unless normal fusion with the ureter occurs.

Three cases of bilateral renal agenesia from a series of 27,000 autopsies are reported. This makes the total number of reported cases 124. Besides the 3 cases described in this paper, only 3 cases in which the abnormality has been limited to the mesonephric and metanephric systems have been reported.

Twenty-seven cases of unilateral renal agenesia are cited. Fourteen of these were encountered in a series of 27,000 autopsies at the Los Angeles County Hospital, a ratio of 1 to 1,929. Five cases were found in a series of 1,831 autopsies at the Huntington Memorial Hospital, an incidence of 1 in 366 autopsies. The ratio for the combined series is 1 case to 1,517 autopsies. Nation also reports 6 clinical cases.

There were 18 (67 per cent) males and 9 (33 per cent) females. In the series of autopsies, unilateral renal agenesia was 20 per cent more common in males than in females (figure corrected for the fact that 60 per cent of all of the autopsies were performed on males).

In the series of clinical cases, all the patients were under 49 years of age. The right and the left kidney were absent with equal frequency. The adrenal gland was present in 17 cases and was recorded as absent in none. In 21 cases (77 per cent) the ureter and half of the trigone were absent. The solitary kidney was always enlarged unless shrunken by disease. In 58 per cent of the cases in which autopsy was performed there were congenital abnormalities of the single kidney. In 22 per cent of the cases the single kidney was diseased; in 6 cases renal failure was the cause of death (congenital inadequacy of the single kidney in 3 cases and renal disease in 3 cases).

Four (44 per cent) of the women had developmental defects of the genital organs. Two (11 per cent) of the men had such defects. Only 3 (21 per cent) of the patients on whom autopsy was performed had hypertension.

There is no reliable clinical sign which guarantees the differentiation of renal agenesia and renal aplasia.

Culp [2] states that secondary lesions sometimes develop in horseshoe kidney and may be of any of the pathologic types which affect a nonfused kidney. A horseshoe kidney with secondary pathologic involvement represents the most com-

This article has been released for publication by the Division of Publications of the Bureau of Medicine and Surgery of the United States Navy. The opinions and views set forth in this article are those of the writers and are not to be considered as reflecting the policies of the Navy Department.

1. Nation, E. F.: Renal Agenesia: A Study of Thirty Cases, Surg., Gynec. & Obst. **79**:175-181 (Aug.) 1944.

2. Culp, O. S.: Treatment of Horseshoe Kidneys, Ann. Surg. **119**:777-787 (May) 1944.

mon type of horseshoe kidney which is recognized clinically, and the symptoms usually are due to the secondary pathologic process. Secondary disease of major significance should be treated by heminephrectomy. Less radical procedures which preserve both halves of the kidney (for example, pyelolithotomy) should be accompanied with symphysiotomy and nephropexy on the side of the kidney because of the danger of remaining symptoms attributable to the fusion alone.

A small, but distinct, group of horseshoe kidneys without a secondary pathologic process presents vague symptoms in the abdomen or back, which may be mistaken for indications of a gastrointestinal disorder or a pathologic condition in some other system. Apparently the symptoms of the "horseshoe kidney syndrome" are produced by pressure on adjoining nerves by the isthmus of fusion or by the ectopic renal masses. Relief is obtained by symphysiotomy and nephropexy. In a few cases of this syndrome it may be necessary to perform a nephropexy on the opposite side also before complete relief is obtained.

For all surgical procedures on horseshoe kidney the conventional extraperitoneal-lumbar approach is satisfactory and is the one of choice.

Culp adds another case to the small group in which treatment with symphysiotomy and bilateral nephropexy was successful. Pyelolithotomy also was performed in this case. Recurrent calculi were recognized early and were dissolved with "solution G," a solution of citric acid, magnesium oxide and sodium carbonate of p_H 4, after irrigation of the renal pelves through indwelling ureteral catheters. The patient has been followed for seven months, with no further recurrence of calculi or symptoms.

Horseshoe kidney is usually the result of union of the lower poles and seldom of union of the upper poles, the latter type being often accompanied by other anomalies, such as horseshoe adrenals, diaphragmatic hernia and spina bifida. Of great importance is the anomalous blood supply of this double kidney. The arteries usually enter the kidney posterior to the pelvis and vary in number from four to six, with one or two entering the symphysis. The ureters cross in front of the symphysis, and anomalous, or aberrant, arteries are the rule, often taking their origin from the arteries of adjacent structures.

Tumors.—Wilms's Tumor: Eliason and Stevens [3] report a case of Wilms's tumor (embryonal carcinosarcoma of the kidney) in a horseshoe kidney. The patient, a child of 6 years, had a large abdominal tumor and a high fever. An intravenous urogram showed a horseshoe kidney. There was a large, soft tissue mass containing calcium in the left upper quadrant of the abdomen, above the renal area. A transperitoneal incision was made, and a tumor was observed arising from the upper pole of the left segment of a horseshoe kidney. The lesion, including the entire left renal component, was removed without difficulty, the horseshoe kidney being divided at its symphysis. The pathologic diagnosis was embryonal sarcoma of the kidney.

In regard to the treatment of Wilms's tumor there are two schools of thought. The older school advocates preoperative irradiation over the growth, with two objects: (1) to reduce the size of the local mass, so that it will be technically easier to remove, and (2) to kill off the more malignant, radiosensitive cells in the tumor and thus prevent their escape into the blood stream during the operative manipulation.

Ladd, who has had the greatest personal experience with the problem at the present time, recommends removal of the mass as soon as it is discovered, the transperitoneal approach being used, with ligation of the renal vessels before manipulation of the mass. He is convinced that roentgen ray therapy has been too widely employed, without consideration of the end results. Perhaps the most convincing arguments in favor of his thesis are the reputed cures. The few apparently cured patients referred to in the literature received no preoperative irradiation. During the last eight years Ladd has removed 22 Wilms tumors, with no operative mortality, thus refuting the statement that preoperative irradiation is necessary to insure a low operative mortality. Listed in his series as probably cured of renal embryoma are 14 of a series of 56 patients, who were alive and well from two to twenty-one years after operation. Only 1 of the 14 patients had preoperative irradiation.

Bothe, in an analysis of 44 cases from the literature, observed that recurrences and metastases were reported in some instances ten years after removal of the primary growth. With this possibility in mind, he states that the skeptical analyst would accept but 8 of the 44 cases as instances of cure. It is important to note that in these 8 cases neither preoperative nor postoperative irradiation was carried out. He adds 7 personal cases in which treatment without previous irradiation was employed. Finally, he states that he agrees with Ladd that immediate removal of these mixed tumors, or embryomas, gives a better chance of cure than do irradiation and delayed nephrectomy.

3. Eliason, E. L., and Stevens, L. W.: Wilms' Tumor in a Horseshoe Kidney, Ann. Surg. **119**:788-790 (May) 1944.

Gutiérrez speaks of the "horseshoe kidney disease" and states that in horseshoe kidney, nephritis, pyelitis, pyonephrosis or stone almost invariably develops sooner or later, with resultant death. The horseshoe kidney is not immune to hypernephroma or papillary carcinoma but rarely produces the Wilms lesion. Eliason and Stevens could not find the report of a single case of Wilms tumor in a horseshoe kidney.

Adenoma: Higgins [4] reports 6 cases in which a large benign adenoma of the kidney was removed surgically, and he reviews a collected series of 29 cases of large adenoma of the kidney, with surgical intervention in 26 instances. As a papillary adenoma of the kidney enlarges, structural changes may occur and produce a tumor which is histologically similar to hypernephroma. From available data and histologic study it may be assumed that in some instances malignant epithelial tumors of the kidney develop from papillary adenomas. A large adenoma of the kidney which produces symptoms and requires surgical removal is rare.

Other Malignant Growths: Bandler and Roen [5] state that the most common tumor of the urogenital tract in children is Wilms's tumor of the kidney. Diagnosis can be made in most instances by urographic examination. Preoperative and postoperative roentgen ray therapy should be given. The transperitoneal approach for removal of the kidney should be employed. Less frequent are tumors of the adrenal gland, bladder, prostate and testis, but the possibility of their existence, even in young persons, must be emphasized and thorough search made for signs of these highly malignant growths. Early diagnosis of malignant disease of the genitourinary tract in children is necessary for successful therapy. In all cases combined treatment with roentgen irradiation and operation should be resorted to; roentgen ray therapy should not be employed alone except in cases in which widespread metastases are present.

Calculi.—Bugbee [6] reports 2 cases in which nephrolithotomy for recurrent branching calculi was performed by a new technic. Briefly, the procedure was as follows: An incision was made posterior to and below the scar of the primary operation. Because the line of this incision was devoid of scar tissue and because it was well posterior to the reflection of the peritoneum, the new incision could be readily carried through the various layers of the abdominal muscles and the lumbodorsal fascia down to the perirenal fascia. The upper flap was freed to the level of the last rib, the scar tissue of the former operation being elevated with this flap. In the 2 cases cited, the kidney was placed high up under the last rib, where such kidneys usually are when firmly adherent, especially when they have previously been drained by nephrostomy. The twelfth rib was resected, and the branching calculus in the pelvis and lower calix could then be easily palpated through the perirenal fascia and the thinned-out renal parenchyma without separating the renal fascia from the adherent kidney. One incision was made extending through the perirenal fascia and the renal parenchyma on a line approximately just posterior to the convex border of the kidney and was deepened until the calculus was freely exposed, lying in the pelvis and the lower calix. The calculus in each instance was readily removed and the kidney drained by a tube placed in the lower calix. The renal incision was then closed with mattress sutures, which were passed through the perirenal fascia and thinned-out renal parenchyma on each side of the incision. The fascia prevented these sutures from tearing through the parenchyma and offered excellent resistance when traction was applied in tying the sutures, so that the bleeding was completely controlled. The fibrous tissue in the abdominal wall and the scar of the first operation were then excised, and the abdominal wound was closed in layers about the drainage tube. In both these cases there was no postoperative bleeding, the drainage tube was removed in from seven to ten days and the wound had completely closed in two weeks.

De la Peña and de la Peña [7] report a case which illustrates the time necessary for formation of a large staghorn renal calculus. The patient, a woman aged 37, stated that during the past three years she had suffered periodically from colicky pain which was referred to the left renal area. She stated that she had been operated on elsewhere a year before; according to the history, drainage of the left kidney had been done. The tube was allowed to remain for two months, and the wound closed spontaneously after its removal. A roentgenogram of the urinary tract revealed two small stones in the left renal area. There was no evidence of any shadow in the right renal area. A month later she was seized with severe colic referable to the lumbar

4. Higgins, C. C.: Adenoma of the Kidney: Report of Six Cases, Am. J. Surg. **65**:3-14 (July) 1944.

5. Bandler, C. G., and Roen, P. R.: Tumors of the Urogenital Tract in the Young, Am. J. Surg. **65**: 306-314 (Sept.) 1944.

6. Bugbee, H.: Nephrolithotomy for Recurrent Branching Calculi, J. Urol. **52**:99-107 (Aug.) 1944.

7. de la Peña, A., and de la Peña, E.: Case Report Illustrating Brief Period of Time Necessary to Formation of Large Stag-Horn Renal Calculus, J. Urol. **52**:108 (Aug.) 1944.

area on the right side, with fever. A plain roentgenogram made thirty-eight days after the previous one showed a large staghorn calculus filling the right renal pelvis. The patient refused to undergo operation.

Ptosis.—Bandler, Pinck and Roen [8] reviewed 55 cases of nephroptosis deemed suitable for surgical suspension. They believe that operation solely for the correction of excessive renal mobility in the absence of symptoms or stasis is not warranted. Nephropexy alone, without correction of concomitant renal or ureteropelvic lesions, is doomed to failure. A properly performed nephropexy not only demands suspension in a high position but requires fixation, so that the proper renal axis is obtained. This is obviously necessary for adequate drainage of the renal pelvis.

There are specific indications for fixation of the kidney. It must be definitely established that symptoms are referable to the urinary tract. Investigation of nonurinary disturbances, such as gastrointestinal distress, must be complete before such symptoms are attributed to the abnormally mobile kidney. Excessive renal mobility must be demonstrated by urographic examination with the patient in both the erect and the recumbent posture. Simulation of pain by overdistention of the pelvis on the affected side with retrograde catheterization is a helpful, but by no means essential, diagnostic criterion. Renal displacement, despite the absence of evidence of constant obstruction to urinary outflow, may require fixation of the kidney because of frequent and severe pain, such as occurs in repeated Dietl's crises. When infection is present and yet no stasis can be demonstrated, conservative measures directed toward elimination of the infection should be attempted first. On the other hand, the observation of definite stasis and obstruction to the urinary outflow, in addition to the ptosis, would appear to make the surgical procedure even more imperative.

Trauma.—Adams [9] analyzed 7 cases of severely ruptured kidney. In 6 cases early operation was performed. In 1 case there was associated rupture of the spleen. There were no deaths. The importance of early operation is stressed, but only after primary shock from trauma to nerve plexuses about the renal pedicle is controlled and before secondary shock from hemorrhage occurs. Preoperative evidence of urinary extravasation can be demonstrated satisfactorily by intravenous urograms. Retrograde urographic examination is thought to be unnecessary and undesirable except when additional information is essential. Urinary extravasation always indicates severe injury of the kidney and is felt to be a specific indication for operation. The presence or absence and the degree of hematuria are not criteria of the severity of renal damage.

Subcapsular Extravasation.—Baretz [10] discusses renal hydrocele. It follows a form of renal trauma dependent on the following factors: (1) preexistent hydronephrosis or hydrocalix; (2) injury which produces extravasation from the pelvis or the calix beneath the renal capsule, and (3) slow healing of the tear. A mass in the abdomen in the region of one kidney, with or without a definite history of trauma; increasing size of the mass, increasing abdominal discomfort, and decreased urinary output are suggestive. Cystoscopic examination and retrograde pyelograms may reveal extravasation from the pelvis or calix to the surrounding sac. Early operative intervention with drainage may result in preservation of the kidney. If nephrectomy is indicated, a two stage procedure is advisable.

Aneurysm.—Lazarus and Marks [11] state that aneurysm of the renal artery is a rare clinical entity; they were able to collect only 75 cases from the literature and added a personal case. A history of trauma was elicited in 34.7 per cent of these cases. Among the other etiologic factors associated with this condition are systemic debilitating infections and atherosclerosis.

Pathologically, aneurysms may be classified as true or false. A true aneurysm is a saccular dilatation of an artery containing all the elements of the arterial wall; it results from weakening of the vessel wall, which is caused by involvement of the elastic fibers by sclerosis or fatty degeneration; this degeneration is due to some debilitating systemic infection or atherosclerosis. A false aneurysm is a saccular dilatation of an artery due to trauma, with resulting complete disruption of continuity of the arterial wall, either in part or in its entirety; the limiting walls of the aneurysm from without inward consist of adventitia, laminated blood clot and endothelium.

Small aneurysms of the renal artery usually produce no symptoms. Larger aneurysms, however, usually give rise to symptoms, the most common of which is pain in the loin (62.7 per

8. Bandler, C. G.; Pinck, B. D., and Roen, P. R.: Nephroptosis and Nephropexy: A Critical Review of Fifty-Five Cases, New York State J. Med. **44**:1541-1545 (July 15) 1944.

9. Adams, P.: Traumatic Rupture of the Kidney, Am. J. Surg. **61**:316-323 (Sept.) 1943.

10. Baretz, L. H.: Renal Hydrocele: Subcapsular Renal Extravasation, J. Urol. **52**:184-198 (Sept.) 1944.

11. Lazarus, J. A., and Marks, M. S.: Aneurysm of the Renal Artery—True and False—with Special Reference to Preoperative Diagnosis, J. Urol. **52**:199-215 (Sept.) 1944.

cent of cases). A mass was felt in the loin in 30 per cent of the recorded cases.

The presence in the roentgenogram of an opaque ring shadow with a dense periphery in the region of the renal pelvis is an extremely valuable diagnostic sign of this disease.

The indicated treatment of an aneurysm of the renal artery is immediate nephrectomy, with ligation of the renal artery proximal to the point of origin of the aneurysm.

Lazarus and Marks report a case of aneurysm of the renal artery associated with calculous pyonephrosis in which a correct preoperative diagnosis was made by observing a typical ring shadow on the roentgenogram in the region of the renal pelvis. Owing to the location of the aneurysm, the lesion was missed at operation but was clearly disclosed on pathologic examination of the extirpated kidney.

URETERS

Transplantation.—Young,[12] in discussing transplantation of the ureters into the rectosigmoid, states that Higgins' ability to find the ureters and to transplant them successfully into the bowel in babies only a few months old is a surgical triumph. He questions Higgins' assertion that unless the operation is done promptly in cases of exstrophy the ureters will rapidly dilate and become infected. He has seen many cases of exstrophy of the bladder in which the patients have grown to adolescence, even to 20 or 30 years of age, with no evidence of serious renal back pressure. Lower told Young that in only 2 of the 20 adults on whom he had operated for exstrophy were the ureters dilated when the transplantation was done. It therefore would seem not absolutely essential to operate on babies with exstrophy immediately but would seem safe to wait until later, when perhaps the exstrophy could be cured by operation and urinary control obtained by appropriate plastic procedures done at the same time on the new-formed vesical neck and penile urethra.

Many surgeons have been advising and carrying out removal of the bladder and transplantation of the ureters into the bowel in cases of epispadias. The operation for epispadias with incontinence is not a difficult plastic procedure, and Young believes that the wholesale use of ureteral transplantation and sacrifice of the bladder in these cases are absolutely unjustifiable. A number of boys with epispadias and incontinence on whom Young carried out his plastic procedure have now grown to adult age and have not only normal micturition but normal sexual powers; 1 has produced two children.

Nesbit,[13] in discussing transplantation of the ureters into the rectosigmoid, affirms the statement made by Higgins that operation should be done early on children with exstrophy. Nesbit also states that he has had an opportunity to operate on 7 children under the age of 4 months; the youngest was 1 month old, the second stage procedure being done at the age of 7 weeks. Operation on these children was not difficult.

The author emphasizes one point; There is only one layer of sutures over the anastomosis. Many times operators perform ureteral transplantation on the human being, and in their anxiety to make a good anastomosis they have put in a second line of sutures. This is not only undesirable but distinctly disadvantageous.

Nesbit adds to the record the case of a girl on whom he operated. She was 19 years of age at the time of transplantation of both ureters, four years previous to this report. She became pregnant and delivered a stillborn child at about 5 months, within a year after her operation and subsequent marriage. Just a year ago she delivered a normal child by the birth canal.

Lower,[14] in discussing transplantation of the ureters into the rectosigmoid, states that the reason many dilated ureters are not found in the adult is that most of the children who have them acquire infection of the upper part of the urinary tract and die before they reach adult life. He does not transplant the ureters for epispadias unless he fails to correct the condition by plastic operation.

Immediately after transplantation of the ureters, Lower often finds temporary dilatation of the pelves and calices; within a month or six weeks these structures generally return to normal. He does not believe that excretory urography is a true test of renal function. Recently he saw a case in which an excretory urogram showed a nonfunctioning kidney, but retrograde catheterization of the ureter done a few days after this examination revealed a normal flow of urine from the kidney. The author, therefore, does not accept the evidence of a nonfunctioning kidney from one excretory urogram as final.

The principal indication for ureteral transplantation is incontinence which cannot be corrected in any other way. Of course, the most common cause is exstrophy, and it is doubtful

12. Young, H. H., in discussion on papers of Stevens and Lord, Higgins and Lower, Tr. Am. A. Genito-Urin. Surgeons **36**:286-288, 1943.

13. Nesbit, R. M., in discussion on papers of Stevens and Lord, Higgins and Lower, Tr. Am. A. Genito-Urin. Surgeons **36**:286, 1943.

14. Lower, W. E., in discussion on papers of Stevens and Lord, Higgins and Lower, Tr. Am. A. Genito-Urin. Surgeons **36**:288-289, 1943.

whether incontinence can be corrected simply by a plastic operation on the bladder.

Lower states that the patients have been followed over a period of years and have been restored to normal economic and social life. It is not known just how long the patients may live, but a number have survived twenty years or more in good physical condition.

Goldstein and Berman[15] state that the conventional operation of ureterocutaneous transplantation for diversion of the urinary stream has had its disadvantages and ultimate discomforts. These are (1) periureteral infections with formation of an abscess and sloughing of the ureter, which defeat the purpose of the operation; (2) retraction of the ureteral stump; (3) obstructions in the ureter due to infection, causing strictures, or to the angulation of the ureters, and (4) inability to adjust properly an apparatus, principally because of insufficient length of the ureteral stump.

With the thought that there is a definite place for ureterocutaneous transplantation and that improvement is necessary in the performance of the procedure, both to obtain more comfort for the patient and to obviate unpleasant complications, Goldstein and Berman offer their modification of the conventional ureterocutaneous transplantation, which is performed in two stages, one to four days apart.

Cystoscopic examination should be performed and catheters left in the ureters if possible. An incision through the skin and subcutaneous tissue is made with the curve about 2 cm. more medial to the anterior superior spine than usual. The aponeurosis of the external oblique muscle is incised in the line of its fibers, and the internal oblique and transversalis muscles are split and cut. The fibers of the two muscles are then cut across for about 4 cm. in the line of the cutaneous incision. The underlying peritoneum is pushed medially by blunt digital dissection and is packed off. The ureter is identified and isolated for about 4 cm. above the bifurcation of the common iliac vessels and freed as far as possible toward the bladder; one should make certain to leave sufficient periureteral tissue, with the blood supply intact. A loop of ureter about midway in the incision is brought up on the anterior abdominal wall under tension, and a piece of tubing is placed beneath it. A black silk suture is placed through the periureteral tissue at its most distal point and brought out along the distal arm of the ureter onto the skin to serve as a guide in the second stage. The muscles are then approximated with surgical gut sutures proximal to, under and distal to the loop, space being left around the two arms of the ureter. The fascia is sutured in a similar manner.

The second stage is simple. Three or four of the black silk sutures are removed from the distal portion of the wound, and the skin is spread apart by blunt dissection. Two of the interrupted chromic sutures in the aponeurosis of the external oblique muscle are removed distal to the loop, and these tissues are separated. With the black silk suture previously inserted into the distal arm of the ureter as a guide, this portion of the ureter is bluntly separated from the surrounding muscles and fascia down toward the bladder. The ureter is doubly ligated near the bladder, and a clamp is placed just proximal to this. The ureter is bisected, and the proximal stump is brought up on the anterior abdominal wall. A rubber tissue drain is placed down to the distal ureteral stump and brought out in the wound somewhat separated from the point of exit of the ureter. The distal portions of muscles, fascia and skin are closed around the ureter. A urethral catheter, which is later replaced by a Foley catheter, is inserted into the ureter, and petrolatum gauze is placed around the ureteral stump until healing takes place.

With this procedure, there is no retraction of the stump of the ureter, the blood supply remains adequate and there is no possibility of postoperative infection of the wound around the proximal portion of the ureter from infected urine. There results a ureteral stump which protrudes between 2 and 3 cm. from the anterior abdominal wall. The blood supply of the stump appears adequate.

The fundamental principle of the procedure is the establishment of the "right of domicile" of the ureter on the anterior abdominal wall. In the first stage a loop of the ureter is brought up; the ureter is not opened at this time but remains connected with the bladder and is allowed to function. The second stage of the operation involves ligation and bisection of the ureter near the bladder, the proximal stump being brought out to drain. Cystectomy may be carried out at the same time, if so desired.

Intubated Ureterotomy.—Davis[16] discusses intubated ureterotomy and describes a new operation for ureteral stricture. He first applied the principle of the Ramstedt operation for pyloric stenosis to division of a stricture of the upper part of the ureter; the result was satisfactory. Since then a number of other surgeons have reported good results with this technic.

Davis reports a number of cases in detail. In general, the site to be dilated is cut longi-

15. Goldstein, A. E., and Berman, E. F.: Uretero-Cutaneous Transplantation: A New Procedure, J. Urol. **52**:224-234 (Sept.) 1944.

16. Davis, D. M.: Intubated Ureterotomy: A New Operation for Ureteral and Uretero-Pelvic Stricture, Tr. Am. A. Genito-Urin. Surgeons **36**:21-43, 1943.

tudinally, bands of ureteral tissue being left over the ureteral catheter or over a ureteral bulb. The open areas between the segments of ureteral tissue tend to grow together, filling in the fenestra made by the longitudinal cut. In other cases, large segments of the ureter are removed, with only a thin strand of ureteral tissue remaining; this tissue grows completely around the ureteral catheter, forming a new channel.

In this intubated ureterotomy, no effort is made to draw the tissue into a new form, and no sutures are used. The operation depends on the physiologic processes of repair of the tissues. The splint is a mold on which the tissues, by their own proliferation, reform the ureteral channel to normal size and shape. It must, therefore, be left in place until this proliferation is completed and the new channel lined with epithelium.

BLADDER

Diverticulum.—Hamilton [17] reports a series of 22 cases of diverticulum of the urinary bladder encountered during the past sixteen years. In all the cases in this series the patients were men and the average age was 65 years. The diverticulum was removed in 9 cases: In 4 cases the prostate was removed at the same time; in 1 case the middle lobe only was removed at the same time; in 2 cases the prostatic portion of the urethra was digitally dilated, and in 2 cases the prostate was not touched.

It is only since the routine use of the cystoscope that the relative frequency of diverticulum of the bladder has been discovered. In 3 cases of Hamilton's series the cystoscope could not be passed through the prostate. The most common situation for a diverticulum is just above and lateral to a ureteric orifice, in an area where one often sees the earliest signs of fenestration in an otherwise normal bladder. The orifice of a diverticulum is usually circular, and the dark interior is not illuminated with the cystoscope lamp.

After the orifice of a diverticulum is discovered, a ureteric catheter is passed. If the whole catheter coils up in the diverticulum, a roentgenogram is made with the cystoscope still in position. Then a diverticulogram is taken after the injection of 20 cc. of a 12.5 per cent solution of sodium iodide along the ureteric catheter. This procedure is especially useful when the diverticulum is on the posterior wall of the bladder, as an anteroposterior cystogram will not show it and a lateral or an oblique cystogram is not always satisfactory. If the diverticulum is large, the 20 cc. will not fill it completely; in this case the cystogram will probably show it up better.

The two factors in the production of a diverticulum appear to be weakness in the vesical wall, either congenital or acquired or both, and a chronic obstruction to the outflow of urine at the vesical neck or in the urethra.

Infection is liable to occur because of the stagnation of urine within the diverticulum. It may result from the first passing of an instrument. Suprapubic drainage of the bladder is likely to precipitate and aggravate this infection. Infection once established in a bladder with a diverticulum is almost impossible to clear up without removal of the diverticulum. Stagnation and infection predispose to formation of calculus. In Hamilton's series there were 4 cases of calculus in a diverticulum. One was a dumbbell calculus that had broken off.

A considerable number of cases of tumor in a diverticulum have been reported. Hamilton observed 1 case, an instance of malignant papilloma, in his series. In another case a papilloma was present in the bladder just outside the diverticulum. In 2 cases perforation resulted from ulceration following severe infection. Rupture took place into the peritoneal cavity.

Hamilton discusses 6 cases in which the diverticulum was not removed. In 2 of these cases no treatment was carried out. In 3 cases suprapubic prostatectomy was done, and in 1 case endoscopic resection of the prostate was carried out. In 1 of the 3 cases in which prostatectomy was performed, a stone developed in the diverticulum two and a half years later, and there were no symptoms until a piece broke off. In another case death, due to pyelonephritis, occurred eleven months after operation. In the third case the patient lived for six years and died of senility. The patient with the endoscopic resection died ten years later of uremia; his urine remained infected throughout this period. In the last case in this series the patient was not seen for three years after the diagnosis was made. He then had gross infection and died of uremia, no treatment having been carried out.

Burns [18] states that diverticulum of the urinary bladder is most often seen in men between the ages of 50 and 70 with benign hypertrophy of the prostate. The development of a diverticulum should probably be ascribed to congenital and acquired factors. The symptoms are not pathognomonic and may even be absent. Complications include infection, calculus, tumor, hemorrhage, damage to the corresponding ureter

17. Hamilton, A. J. C.: Diverticulum of the Urinary Bladder: A Series of Twenty-Two Cases (Honyman Gillespie Lecture), Edinburgh M. J. **50**:513-534 (Sept.) 1943.

18. Burns, E.: Diverticula of the Urinary Tract, Selected Writings by Staff Members of Ochsner Clinic, **3**:40-48 (June 30) 1944.

and rupture. The diagnosis may be made from thorough cystoscopic examination of the bladder and complete roentgenologic studies of the entire urinary tract. The trend is toward conservatism in treatment. Retentive diverticula which are badly infected and diverticula associated with stones or neoplasms should be removed. Burns prefers to perform diverticulectomy first in cases in which treatment of obstruction at the vesical neck, as well as removal of the diverticulum, is required.

Trauma.—Ross [19] states that injury of the bladder is not a common condition in civilian emergency surgical cases, but that the incidence increases as a result of the numerous penetrating wounds of modern warfare. He describes a series of cases which occurred within a brief period, each case being a classic example. A further point of interest is the absence of deaths. This observation is in disagreement with the view of earlier writers. In a series of 965 cases of abdominal injury sustained in World War I which were analyzed by Wallace, the bladder was injured in 45, or 4.66 per cent. Fullerton was able to collect a series of only 53 cases.

A full bladder is more prone to injury than one lying empty deep down in the pelvis. Larrey, who, as Napoleon's surgeon general, must have had a wide experience with wounds, pointed out this fact over a century ago. A full bladder presents a larger target than the empty organ; and if projecting above the pubis, it may be injured by a penetrating wound without damage to the bony pelvis.

The three main injuries are contusions, wounds and ruptures. Contusions are rare and difficult to recognize. They are usually due to prolonged and difficult labor, produce injury of the trigone muscle and may eventually predispose to the formation of a cystocele.

Wounds are generally of military origin and frequently of the penetrating type, although an occasional injury of the bladder during hysterectomy, especially vaginal hysterectomy, has been recorded. A punctured wound may temporarily seal itself off, as bullets tend to split the muscular fasciculi. In 4 of Fullerton's 53 cases the wound was situated in the suprapubic area; in 34 the wound of entry was in the region of the buttock, and in 5 the wound of exit was similarly situated. Thus, in 39 of 53 cases (75 per cent) a wound communicating with the bladder was found in the area of the buttock. In many instances the foreign body is retained, and in 10 of the 53 cases it was found in the bladder.

19. Ross, J. C.: Injuries of the Urinary Bladder, Brit. J. Surg. **32**:44-49 (July) 1944.

Inebriation is a well known predisposing factor in rupture of the bladder, especially when it is combined with a sharp blow on the hypogastrium. Not only is the bladder overdistended, but the abdominal musculature is not on guard.

Injuries of the bladder are divided into intraperitoneal and extraperitoneal lesions. Penetrating wounds of the abdomen usually cause intraperitoneal lesions, while missiles entering the pelvis via the buttock, thigh or perineum are more likely to produce extraperitoneal lesions. Intraperitoneal injuries usually affect the dome and the posterior wall of the bladder and lead eventually to peritonitis. Extraperitoneal lesions are situated anteriorly, laterally or at the base of the bladder and produce extravasation of urine and pelvic cellulitis.

In military practice extraperitoneal injuries are four times as common as intraperitoneal injuries, whereas in civil practice 80 per cent are intraperitoneal. Some authorities claim that in mining districts the percentage of extraperitoneal injuries rises with the frequency of fracture of the pelvis.

The majority of vesical injuries are complicated by injuries, sometimes even more serious ones, of other organs. Practically all extraperitoneal injuries are associated with fracture of the pelvis, the horizontal ramus of the pubis being most commonly involved. In general, intraperitoneal injuries are associated with peritonitis, and extraperitoneal injuries, with pelvic cellulitis.

For uncomplicated injuries the mortality has been estimated as greater than 50 per cent. The prognosis for intraperitoneal lesions is obviously graver when the small intestine is involved; "the picture is dismal in the extreme; in sixteen instances there was only one recovery." The importance of early operation is emphasized in cases of civil injuries. The mortality is 11 per cent if operation is carried out within twelve hours after the injury, 55 per cent if operation is delayed for twenty-four hours and 100 per cent if no operation is performed. It is evident, however, that the complications are also vital factors and that their presence or absence influences the final outcome to a great extent.

While in many cases intraperitoneal injury produces a high degree of shock, this is by no means an invariable accompaniment. The clinical features are conveniently divided into two stages: 1. During the first twenty hours severe shock and pain are accompanied with desire to void urine but with inability to do so. There are also symptoms of peritonism, slight generalized abdominal distention and some degree of rigidity. Free fluid is present. 2. After the first twenty hours

signs of generalized peritonitis, and perhaps ileus, supervene.

With extraperitoneal injuries shock is not so prominent, but stranguria is usually a feature. It is important to distinguish the latter condition from rupture of the posterior portion of the urethra, with which the distended bladder can be readily felt. Later, pericystitis is followed by development of an abscess, which may point in the space of Retzius.

One must consider four cardinal features in making a diagnosis: history of injury in the region, presence of shock, inability to void urine and evidence of blood on passage of a catheter. Among the various diagnostic methods advised, intravenous pyelography appears innocuous; and, if time and facilities are available, it may prove helpful, if not diagnostic. On the other hand, the taking of a plain roentgenogram to determine the position of a foreign body or the presence of fracture of the pelvis is indicated if time, facilities and the patient's condition permit. Since in some cases the fecal fistula, if one is present, communicates with the rectum, sigmoidoscopy may be helpful under certain circumstances.

The passage of a catheter will demonstrate patency of the urethra; it may reveal distention of the bladder, and therefore absence of leakage (absence of more than a drop or two of urine suggests that the bladder has perforated, and an empty bladder indicates an intraperitoneal leak), and perhaps the presence of pure blood or blood-stained urine.

Cystoscopic examination, if done with care, involves no more danger than does catheterization, and sometimes the diagnosis cannot be made by any other method. Cystoscopic examination will give a correct diagnosis in 85 per cent of cases, and, provided subsequent operation is prompt, it does not add to the risk.

Amyloidosis.—Corbitt, Broders and Pool [20] report a case of amyloidosis of the urinary bladder. The patient, a woman aged 29, had had "bladder trouble" for ten years. Cystoscopic examination showed that the capacity of the bladder was reduced. A large fungiform growth extended from about 1 cm. above the left ureteral orifice up on the left lateral wall and involved the dome and part of the right lateral wall. Multiple specimens showed amyloid degeneration. Because of the location of the lesion and the possibility that it might overlie an infiltrating type of vesical neoplasm, it was thought advisable to explore the bladder, with the intention of making a segmental resection if possible. This was done, and the lesion was found to be resectable. About 50 per cent of the bladder was resected. The postoperative course was uneventful. Grossly the section removed was indistinguishable from a neoplasm. Microscopic study revealed amyloidosis.

Actinomycosis.—Hatch and Wells [21] report a case of actinomycosis of the urinary bladder which was apparently secondary to long-standing actinomycosis of the foot and lower part of the leg. After several short periods of hematuria during the course of two years, the patient died of exsanguination.

Xanthic Calculus.—Butt and Holliman [22] report a case of xanthic calculus, the nineteenth to be recorded in the literature. The stone was removed from the bladder of a white man aged 28 and was associated with constriction at the left ureterovesical junction and dilatation of the left ureter and the left renal pelvis.

Gumma.—Ormond and Hemming [23] report a case of gumma of the bladder. The patient, a woman aged 60, had frequency, dysuria and hematuria. Cystoscopic examination revealed a large, ulcerated, protruding area on the left side of the floor of the bladder, which simulated ulcerated incrusted cystitis or tumor of the bladder. The Kolmer and Kahn tests gave 4 plus reactions. On this basis, the condition was diagnosed as gumma of the bladder, and the patient was given antisyphilitic treatment. Cystoscopic examination a month later revealed that the bladder was clear although the mucosa of the bladder was somewhat edematous.

The symptoms of gumma of the bladder are not characteristic and are essentially those of any vesical irritation. Hematuria may be one of the first symptoms and is usually present in cases of tertiary syphilis of the bladder. Frequency, urgency and dysuria are commonly associated with this condition. It has been stated that pain is more severe the closer the lesion is to the vesical orifice.

With tertiary syphilis of the bladder the gummatous ulcer is the most frequent lesion, although it may coexist with the papillomatous lesion. The ulcerating gumma may be either single or

20. Corbitt, R. W.; Broders, A. C., and Pool, T. L.: Amyloidosis of the Urinary Bladder, J. Urol. **52**:153-157 (Aug.) 1944.

21. Hatch, W. E., and Wells, A. H.: Actinomycosis of the Urinary Bladder Complicating a Case of Madura Foot, J. Urol. **52**:149-152 (Aug.) 1944.

22. Butt, A. J., and Holliman, H. D., Jr.: Xanthine Calculus: A Case Report, J. Urol. **52**:89-91 (July) 1944.

23. Ormond, J. K., and Hemming, J. G., Jr.: Gumma of the Bladder: Report of a Case, J. Urol. **52**:23-26 (July) 1944.

multiple. It is usually grayish yellow, with infiltrated margins; the base is covered by a clot or necrotic tissue and is usually surrounded by a zone of inflammation. The most frequent site of the gumma is the region of the trigone, especially around the ureteral orifices, but the lesion may be present on any part of the bladder wall. Perforation occurs as a result of the progress of gummatous ulcers and vesicoperitoneal and vesicorectal fistulas.

Neither the picture obtained on cystoscopic examination nor the symptoms of this lesion are characteristic. Therefore the cystoscopic picture must be supported by the following factors: previous history of syphilis, evidence of active syphilitic lesion at the time, positive reactions to serologic tests, absence of other etiologic factors and progressive decrease in symptoms and disappearance of the lesions, as shown by repeated cystoscopic examinations following antisyphilitic therapy.

The treatment of gumma of the bladder is the specific treatment of syphilis. Local treatment is of no known value for this condition.

The prognosis on the whole is good. However, every effort should be made to safeguard against a relapse, and the patient should be followed closely for some time. Recurrences of syphilitic lesions of the bladder have been reported; however, these lesions have usually responded to renewed antisyphilitic therapy.

Stress Incontinence.—Macky[24] describes an operation for the cure of stress incontinence in females. Stress incontinence is a condition in which the urine passes uncontrolled from the urethra when the patient makes any effort tending to increase abdominal pressure.

Macky opens the bladder suprapubically. His main objective is to repair the internal sphincter, which is usually deficient posteriorly, without impairing the action of the muscle of the trigone. To do this it is necessary first to dissect the trigone free of the underlying sphincter and the circular inner muscle layer, rejoin the torn sphincter and then replace the trigone. This is done without disturbing the origin or insertion of the trigone muscle. The limits of the trigone are readily distinguished. There are two veins in the region of the ureteric orifices, which proceed along the lateral borders of the trigone. A small incision is made on the outer side of each of these veins and at the middle of the side of the trigone. The mucous membrane is divided and the incision deepened by blunt dissection. A thread of surgical gut is drawn under the trigone, slightly above the middle. This can be held in a forceps, and it acts as a tractor. Incisions are then carried down on each side of the orifice, and the apical portion of the trigone is dissected until the lower portion inside the bladder is clear, the apex remaining in the posterior portion of the urethra. This provides a tunnel under this section of the trigone. Further dissection discloses the remains of the sphincter. A mattress suture is then passed through the tunnel, taking a good portion of the muscle on each side. When this is tied, the severed ends are drawn back to their original position beneath the trigone. A suprapubic drain is left in place for three weeks to prevent the repaired sphincter from being under strain.

24. Macky, F.: An Operation for the Cure of Stress Incontinence in the Female, J. Urol. **52**:27-35 (July) 1944.

PROSTATE GLAND

Operations on the Prostate.—Briggs[25] discusses the operations on the prostate reported on by candidates for membership in the American Urological Association.

The candidates average middle age before qualifying for membership in the association; most of them have had almost four years of hospital training, although not all that time has been devoted to urology.

Five hundred and seventy, or approximately 46 per cent, of 1,238 major operations reported were performed for some type of obstruction at the vesical neck.

Cystotomy was performed on 17 extremely ill patients because of intravesical hemorrhage, impassable strictures or some other compelling condition. Five hundred and fifty-three patients underwent some type of operation on the prostate, such as resection, one or two stage suprapubic prostatectomy or perineal prostatectomy.

The mortality for the entire series of operations, including the 17 "must" cystotomies, was 5 per cent. If the 7 deaths following the 17 cystotomies are excluded, as they should be because they were not performed on the prostate, the mortality for the 553 operations on the prostate was 3.9 per cent.

There were no deaths following the 33 perineal operations; for the 122 two stage suprapubic prostatectomies there was a mortality of 3.3 per cent; for the 338 resections, a mortality of 3.84 per cent, and, finally, for the 54 one stage supra-

25. Briggs, W. T.: Analysis of Prostatic Operations Reported by Candidates for Membership in the American Urological Association, J. Urol. **52**:158-160 (Aug.) 1944.

pubic enucleations, a mortality of 7 per cent, the highest rate observed.

The mortality of 3.84 per cent for the 338 resections is about what might be expected by any but the expert surgeon, since Nesbit reports a mortality of 3.6 per cent in 365 cases in which resection was performed by his residents.

The absence of death following the 33 perineal operations is in keeping with Young's statistics. For instance, in 1936 he reported that his last four resident urologists at the Brady Institute had performed 190 consecutive perineal prostatectomies, with 4 deaths, or a mortality of 2.1 per cent.

In his review of the postoperative notes on the resections, Briggs gained the impression that had it not been for the sulfonamide compounds the mortality for this group would have been much higher.

Emmett [26] discusses transurethral resection and open prostatectomy. In the ten years between 1933 and 1942, 8,954 transurethral resections were performed at the Mayo Clinic. During the same period transurethral resection was done in 102 cases in which suprapubic or perineal prostatectomy had been performed previously. The tissue removed in 66 of these cases was benign, while that removed in 36 cases was malignant. In 16 of the 36 cases in which the tissue was malignant, open prostatectomy had been done more than ten years before the transurethral resection. It must be assumed, therefore, that the original prostatectomy had been done for benign prostatic hyperplasia. This would tend to dispel the prevalent idea that so-called total prostatectomy necessarily gives protection from subsequent development of carcinoma of the prostate gland. It was also noted that in 7 of the 36 cases resection was performed within less than a year after prostatectomy. In 14 of the 36 cases the patients had suffered from obstructive symptoms continually since prostatectomy. The immediate results of transurethral resection in these cases were gratifying. Excellent results were secured in 29 cases.

In the 66 cases in which the tissue removed at transurethral resection was benign, the interval between prostatectomy and subsequent resection varied greatly. In 31 of these cases prostatectomy had been done more than ten years previously. In the majority of the cases prostatectomy had been performed by a surgeon well trained in prostatic surgery; therefore, it must be assumed that the enucleation had satisfactorily approached completeness in most cases. In 20 cases open prostatectomy had been performed less than two years previously, while in 8 cases the interval was longer but prostatectomy had been performed less than five years previously. In these 28 cases the results of prostatectomy can definitely be classified as unsatisfactory. The most common symptom in the 66 cases was recurring obstruction of the urinary tract.

In 23 of the 66 cases the pathologic condition at the vesical neck was postoperative cicatrization or contraction. The scar tissue in many of these cases was dense and firm, and grossly it suggested carcinoma. In the remaining 43 cases the obstruction was produced by varying amounts of adenomatous tissue.

In 50 of the 66 cases the results were excellent, and in 13 cases the condition of the patients was greatly improved.

Emmett discusses incomplete and complete transurethral resection and reviews the experience at the Mayo Clinic for the period from 1933 to 1942 inclusive. In 1934, 696 transurethral resections were performed on 630 patients. In no instance was more than 55 Gm. of tissue removed at one stage, and in 87 per cent of the cases less than 35 Gm. was removed. Of the 696 resections, 64 (9.1 per cent) were second resections, which were done while the patient was still in the hospital because insufficient tissue had been removed to allow the patient to empty his bladder. These figures can be compared with those for 1942, during which 1,276 resections were performed on 1,233 patients. Of this number of resections, only 43 (3.4 per cent) were second resections or planned two stage procedures, done while the patient was still in the hospital. During 1942 more than 50 Gm. of tissue was removed (in one stage) in 217 cases and more than 100 Gm. in 13 cases. The largest amount of tissue removed at one stage during this year was 141 Gm. The mortality rate in 1934 was 0.3 per cent. In 1942 it was 1.1 per cent. It is evident that many of the resections in the earlier years were incomplete; consequently, it must be expected that some of the patients have required, or will require, another surgical operation on the prostate.

From six to ten years have passed since the early period of the incomplete type of resection, as carried out from 1933 to 1937 inclusive. Even for this period, in only 7.4 per cent of the cases in which the tissue removed at the first transurethral resection was benign did the pa-

26. Emmett, J. L.: Transurethral Resection and Open Prostatectomy: A Consideration Based on Ten Years of Experience with Transurethral Resection, Surg., Gynec. & Obst. **79**:449-456 (Nov.) 1944.

tient return to the clinic for subsequent resection. If the years 1933 and 1934 are eliminated, the percentage of subsequent operations on patients whose original operation was done in 1935, 1936 or 1937 was only 4.4 per cent.

Emmett states that the main factor in recurring symptoms is incomplete removal of tissue. Many patients have enjoyed normal lives, free of urinary symptoms, for ten years or longer, and are still free of symptoms after an incomplete resection performed years ago. There seems to be no doubt that complete removal of the adenomatous tissue is desirable and guarantees the best immediate and late results. Nevertheless, it should also be appreciated that such a complete enucleation, performed transurethrally, carries more operative risk than a less thorough operation.

Of the 8,465 transurethral operations performed at the Mayo Clinic from 1933 to 1942 inclusive, the mortality rate in cases in which more than 70 Gm. of tissue was removed was 2.6 per cent, as compared with a mortality rate of 1.2 per cent for the entire series.

Preparation before resection, when necessary, nearly always takes the form of drainage with a urethral catheter. Tests of renal function other than determination of the blood urea are rarely necessary. Long periods of preoperative preparation are unusual. The length of postoperative hospitalization also has been greatly reduced by transurethral resection. Among the 8,422 patients on whom resection was performed at the clinic from 1933 to 1942 inclusive, the average postoperative stay in the hospital was only eight and six-tenths days.

Marshall [27] states that perineal prostatectomy in general has been said to have certain advantages over transurethral and suprapubic methods, particularly in special instances in which the other approaches are contraindicated or would not obtain the desired result. The author points out the advantages of subtotal perineal prostatectomy over perineal enucleation, as follows: An unrecognized small carcinoma will probably be entirely removed, though for a recognized cancer Young's more radical operation is advised unless contraindicated. An infected, fibrotic or stone-bearing "capsule" can be removed. Better control of bleeding is obtained with a visual clamp and ligature. Marshall describes and illustrates a new method of subtotal perineal prostatectomy and discusses the results obtained in a consecutive series of 18 cases. In his hands the method has been an improvement over perineal enucleation.

Carcinoma.—Herger and Sauer [28] state that 50 per cent of their patients receiving diethylstilbestrol medication exclusively responded with regression or softening of the prostate. This inclined the authors to believe that administration of estrogen without castration should have its place in selected cases of prostatic carcinoma. In their opinion, such treatment is indicated (1) for patients with operable carcinoma of the prostate who refuse radical operation; (2) for patients with moderately advanced lesions who have few, or no symptoms; (3) for patients with well differentiated adenocarcinoma, of comparatively low grade malignancy, in whom progression of the lesion is slow (this group includes patients who may live for many years without adequate treatment although the diagnosis of cancer has been proved by biopsy), and (4) for patients who refuse castration or patients for whom orchiectomy is contraindicated, for various reasons.

It is necessary to reexamine all these patients at frequent intervals, and castration should be carried out as soon as there are changes which point to progression of the lesions. Such changes are increase in size of the prostate, with progressive infiltration into the pelvis, development of obstructive symptoms, increase in the serum acid phosphatase activity and other signs and symptoms which suggest metastatic spread of the disease.

Herger and Sauer say that castration should be recommended for all patients with prostatic cancer in whom metastatic lesions are demonstrable and for patients with a type of lesion which usually has a tendency to rapid progression. In addition, castration should be carried out on patients who do not respond favorably to administration of diethylstilbestrol. This procedure has been employed by Herbst, who observed that castration was effective for patients who showed no improvement after treatment with estrogen.

The value of combined diethylstilbestrol medication and orchiectomy is undecided at present. In patients who respond favorably to castration, additional administration of estrogen may accelerate improvement, but Herger and Sauer's experience has shown that estrogen is ineffective for patients who fail to respond to orchiectomy.

27. Marshall, V. F.: Subtotal Perineal Prostatectomy: Presentation of a New Technique, J. Urol. **52:** 250-265 (Sept.) 1944.

28. Herger, C. C., and Sauer, H. R.: The Effect of Orchidectomy and Stilbestrol in Carcinoma of the Prostate, Am. J. Surg. **62:**185-200 (Nov.) 1943.

This view is supported by Herbst, who reported recently that even an increased dose of diethylstilbestrol had no influence on the downhill course of this disease.

Although Herger and Sauer have been impressed by the favorable results accomplished in numerous cases, they do not believe that castration or administration of diethylstilbestrol will result in cures. These methods of treatment are valuable adjuncts, which yield far more favorable results than does palliative roentgen irradiation or interstitial irradiation. Neither castration nor administration of diethylstilbestrol can substitute for surgical removal of carcinoma of the prostate when the gland is still encapsulated. Other methods of palliative treatment, such as transurethral resection or suprapubic cystostomy, will still retain their place in the treatment of carcinoma of the prostate in selected cases.

Barringer and Woodard [29] discuss the determination of acid and alkaline phosphatase in cases of carcinoma of the prostate in which the lesion has metastasized to bone and soft parts. The serum acid phosphatase level of two thirds of their patients with metastasizing carcinoma of the prostate was elevated when the patients were first examined.

The serum alkaline phosphatase level of all patients with osteoplastic involvement from carcinoma of the prostate was greatly elevated. In a few cases the metastatic involvement was osteolytic. In these cases the serum alkaline phosphatase value was normal or slightly elevated.

In patients whose serum acid phosphatase level was initially elevated and who showed a satisfactory clinical response to treatment with diethylstilbestrol or surgical castration, the value for the serum acid phosphatase fell promptly nearly to normal. Patients whose acid phosphatase level failed to show a conspicuous drop within two weeks after the institution of endocrine treatment likewise failed to show clinical improvement.

Two thirds of the patients whose serum alkaline phosphatase value was initially elevated showed a further increase after surgical castration, and one fourth, after the institution of diethylstilbestrol therapy. This rise was usually accompanied by an increase in the degree of osteoplastic involvement. It was not closely related to clinical response.

29. Barringer, B. S., and Woodard, H. Q.: Acid and Alkaline Phosphatase Determinations in Prostatic Carcinoma: Bone and Soft Part Metastases, Tr. Am. A. Genito-Urin. Surgeons **36**:297-303, 1943.

URETHRA

Urethral Repair.—Corbus and Corbus [30] report a case of spontaneous closure of a urethrorectal fistula. The patient, a man aged 68, underwent a perineal prostatectomy. During blunt dissection of the rectum, a thinning of the rectal serosa was observed, although rectal examination showed no perforation. On the seventh postoperative day there were both fecal and urinary drainage through the perineal wound. Rectal examination revealed a mucosal perforation, 1 cm. in diameter, immediately proximal to the anal sphincter on the anterior wall. Suprapubic cystotomy was performed immediately, and the plain urethral catheter was replaced by a 30 cc. Foley catheter. Combined suction drainage, as suggested by Davis, was instituted with the aid of the Wangensteen decompression apparatus. Sulfaguanidine was given in full doses to aid in liquefaction, as well as sterilization of the intestinal tract. The perineal wound was irrigated twice daily, after which a gauze packing impregnated with balsam and a 2 per cent solution of silver to stimulate granulation was inserted. The patient was dismissed from the hospital five weeks later, with both the perineal and the suprapubic fistula closed and no evidence of urethrorectal communication.

Uhle and Erb [31] discuss the incidence, mechanism of trauma and surgical aspects of intrapelvic rupture of the urethra as a complicating factor of fracture of the pelvis. With the more severe types of trauma, in which complete severance of the urethra occurs, with or without displacement of the prostate, immediate suprapubic drainage should be instituted. At the same time an attempt should be made to reunite the severed portions of the urethra by retrograde catheterization. If this is impossible, because of hemorrhage, shock, intra-abdominal injury or extensive trauma to the urethra and bladder, secondary perineal section and urethral anastomosis must be performed in the shortest time compatible with the patient's safety. In 2 of the cases reported by the authors, dense strictures had replaced the membranous portion of the urethra. The patients when admitted to the hospital had draining suprapubic sinuses of four and nine months' duration. Secondary perineal operation for restoration of urethral continuity had not been performed. The technic of perineal section, excision of the stricture and anastomosis

30. Corbus, B. C., Jr., and Corbus, B. C., Sr.: Management of Urethro-Rectal Fistula: Review of Literature and Report of a Spontaneous Closure, J. Urol. **52**:61-62 (July) 1944.

31. Uhle, C. A. W., and Erb, H. R.: Reconstruction of the Membranous Urethra: Case Reports, J. Urol. **52**:42-60 (July) 1944.

of the anterior and posterior portions of the urethra, with preservation of the external sphincter mechanism, is described.

McCague and Semans[32] discuss the management of traumatic rupture of the urethra and bladder complicating fracture of the pelvis. In 133 (or 17 per cent) of a series of 780 cases of fracture of the bony pelvis, rupture of the urethra or bladder was a complication. These consisted of 99 cases of intrapelvic rupture of the urethra, 1 case of rupture of the anterior portion of the urethra, 22 cases of rupture of the bladder and 11 cases of combined rupture of the urethra and bladder.

A critical analysis of this large series of cases was made. This study has established certain principles of treatment as essential in avoiding both the immediate mortality and the late complications. The mortality has been reduced from 78 per cent (reported by Besley through 1907) to 23 per cent (McCague and Semans, 1942). The reduction in mortality depends on the following principles: (1) early and accurate diagnosis; (2) adequate treatment of surgical shock; (3) provision of urinary drainage; (4) surgical drainage of the traumatized tissue, and (5) immobilization of the bony pelvis.

The diagnosis is not difficult. The patient is usually in profound shock. The fractured pelvis causes pain on movement. The legs are rotated outward and cannot be moved. Compression of the pelvis causes exquisite pain and frequently crepitus. The ruptured urethra produces frank blood at the external urinary meatus. On rectal examination, the normal contour of the prostate may be masked by a hematoma. If the urethra has been severed, the prostate is displaced and is not palpable. Unless there is an associated rupture of the bladder, extravasation of urine does not occur early. If there is also rupture of the bladder, the clinical picture differs. There is usually pronounced tenderness in the lower part of the abdomen over the site of the rupture. Instrumentation, including catheterization, contributes little and produces trauma in a patient already in shock.

The most common cause of early death is progressive shock. This is secondary to the crushing blow to the pelvic bones and soft parts. Bleeding from other ruptured viscera may be contributory. Immediate intravenous administration of blood and plasma is strongly indicated.

Extravasation occurs late in cases of urethral rupture unless the bladder is also perforated. Therefore, once the diagnosis is established and the shock relieved, the urine must be diverted by cystostomy. In cases of partial rupture drainage with a urethral catheter alone has been used. But without cystostomy an occluded urethral catheter will soon cause urinary extravasation from the site of rupture. The combined use of a suprapubic and a urethral catheter is ideal. The latter establishes the continuity of the urethra. Sutures are not necessary. The urethra heals rapidly around the catheter.

The soft tissues about the urethra and bladder are usually damaged and contain extravasated blood, and sometimes urine. Sepsis spreads quickly unless hemorrhage into these tissue spaces is completely controlled and the spaces themselves widely drained. A rapid perineal incision, to establish dependent periurethral drainage, is desirable if the patient's condition permits. If not, this procedure can be carried out later. If there is intraperitoneal rupture of the bladder, the peritoneal cavity, as well as the bladder, must be drained to avoid generalized peritonitis.

The fractured pelvis is best treated by immobilizing the pelvic girdle with a firm binder and suspending the pelvis in a sling. The legs are put in extension. This has the added advantage of bringing the two ends of the ruptured membranous portion of the urethra in better apposition.

For reduction of morbidity, unnecessary investigative procedures must be eliminated. The diagnosis is established by physical examination alone, without recourse to catheters and instruments. Preservation of the continuity of the urethra must be effected early, to prevent fibrous tissue from filling the large gap between the torn ends of the urethra. With the legs in extension, anastomosis of the torn ends is unnecessary. Areas of extravasation around the bladder and urethra are thus adequately drained through the abdomen and through the perineum. Except for injuries confined to the anterior portion of the urethra, cystostomy is preferable to drainage with a urethral catheter alone. Secondary infection, sepsis and death have occurred in cases in which only perineal section and anastomosis of the torn ends of the urethra were employed. The same is true with simple urethral catheterization. Almost invariably there is leakage into the mutilated and devitalized tissues at the site of rupture, with subsequent sepsis.

If the urethral continuity is preserved, early stricture of the region of rupture is unlikely. However, in cases of injuries of the bulbous portion of the urethra, produced by a person's falling astride a hard object, healing may result in a constricting scar. Impotence may result if there has been severe damage to the nerve and blood

32. McCague, E. J., and Semans, J. H.: The Management of Traumatic Rupture of the Urethra and Bladder Complicating Fracture of the Pelvis, J. Urol. **52**:36-41 (July) 1944.

supply of the corpora. Nothing has proved successful in preventing this distressing complication.

Fifty-one consecutive cases of fractured pelvis observed in three years (1940 to 1942 inclusive) were studied recently. The average age of the patients was 40 years. There were 6 cases of intrapelvic rupture of the urethra. All were observed within a few hours of the time of injury. On physical examination there was evidence of shock. Discoloration of the scrotum, caused by hematoma, was observed in 2 cases. The operative procedure was similar in all of the 6 cases. As soon as the diagnosis was made and surgical shock was relieved, suprapubic cystostomy was done. In all cases it was feasible at the same time to preserve the continuity of the urethra with a splinting catheter. Perineal drainage was then established by rapid section. In all but 1 case the patient had complete urinary control on discharge from the hospital. Of the 51 cases there were 6 cases of extraperitoneal rupture of the bladder. Suprapubic cystostomy was carried out a few hours after the accident in all but 3 cases. In 2 of these cases death occurred from shock before operation could be done, in spite of intensive therapy. In another case urethral catheterization only was used, extravasation not being evident for eighteen hours following the patient's admission to the hospital. In all cases except the 2 in which death occurred from shock the patient was discharged as well. In these 6 cases there was no intraperitoneal rupture. Extraperitoneal drainage was employed in all cases. The average stay in the hospital was five and one-half weeks.

Urethritis.—Grenley [33] states that in many cases of urethritis the stigmas attached to the term "venereal disease" are lacking and yet the cause, symptoms, course and treatment follow closely those of urethritis following gonococcic infection. He discusses 180 cases of nongonococcic urethritis. There was a history of recent sexual intercourse, with a latent period of less than sixteen days. In no case was there any evidence, either in the history or during the course of the illness, of preexisting infection of the genitourinary tract. The possible causes included direct contact with a woman infected with other organisms than the gonococcus and the use of various irritating chemicals by the woman or by the soldier as prophylaxis. Twenty-eight and nine-tenths per cent of the patients used the official Army prophylaxis; 17.8 per cent used mechanical means (rubber condom), and 46.1 per cent used no prophylaxis. No organisms were found in the urethral discharge in 42.8 per cent of these patients. There were genitourinary complications in 13.3 per cent of the patients, of which urethral stricture was by far the most common. Twenty-nine and four-tenths per cent of the patients required no active treatment; 52.3 per cent were apparently cured with chemotherapy. In uncomplicated cases the average time actually lost from duty was twenty-one and one-half days.

Oard and associates [34] report on the use of penicillin sodium in the treatment of 411 patients with urethritis following gonococcic infection. Combined treatment with moderate doses of sulfathiazole and small doses of penicillin sodium was used with 232 patients. Gonococcic urethritis in the Negro is more susceptible to treatment with penicillin and with penicillin and sulfathiazole combined than it is in the white race. Sulfathiazole and penicillin appear to enhance the effect of each other against Neisseria gonorrhoeae. The combined use of moderate amounts of sulfathiazole and of penicillin is a safe, rapid, efficient and economical method of treating gonococcic urethritis.

TESTES

Tumors.—Barringer,[35] in discussing tumor of the testis, describes the results of autopsy in some 35 cases of teratoma of the testis. The observations are amazing and instructive. Among other results, in practically 100 per cent of the cases in which the patient died, there was bilateral abdominal invasion, due to involvement of the spleen, the kidney, the retroperineal lymph nodes or the lymph nodes which had crossed over. In a large percentage of cases there was renal or perirenal invasion by the tumor. In 75 per cent of all cases in which the lungs were involved, the liver also was affected.

Smith,[36] in discussing tumor of the testis, states that he personally has not performed Hinman's operation because the metastatic lesions of the radiosensitive testicular tumor can be controlled by roentgen ray therapy and in a considerable proportion of the cases the lungs are involved early in the course of the disease. He feels unable

33. Grenley, P.: Non-Specific Urethritis of Venereal Origin, J. Urol. **52**:92-97 (July) 1944.

34. Oard, H. C.; Jordan, E. V.; Nimaroff, M., and Phelan, W. J.: The Treatment of Gonorrheal Urethritis, with Sulfonamides and Penicillin Combined, J. A. M. A. **125**:323-325 (June 3) 1944.

35. Barringer, B. S., in discussion on papers of Smith and Barringer and Woodard, Tr. Am. A. Genito-Urin. Surgeons **36**:305, 1943.

36. Smith, G. G., in discussion on papers of Smith and Barringer and Woodard, Tr. Am. A. Genito-Urin. Surgeons **36**:307-308, 1943.

to differentiate lesions which would not be radiosensitive.

Smith says that this radical operation may be of value for patients who have certain types of teratoma; on the other hand, metastases from a teratoma, which in itself is largely resistant to irradiation, may be radiosensitive. Hinman himself said that operation is useless when the metastatic lesions are palpable; this eliminates a large proportion of the cases. It seems, therefore, that the testicular tumors suitable for this operation are so few as to be difficult to identify.

Smith has not used preoperative roentgen ray therapy because, in the first place, he cannot see why the procedure of cutting down on the spermatic cord and immediately ligating it, before the testis is touched, will induce spread of the metastatic lesion. The distinct disadvantage of preoperative irradiation is that it may make impossible the pathologic diagnosis of the tumor which is removed.

In addition, some testicular tumors are not what one thinks they are, and to give a patient an adequate course of irradiation only to find that he has a fibroma or a leiomyofibroma is unsound.

EPIDIDYMIS

Malignant Tumors.—Crabtree [37] reports a case of teratoma of the epididymis. He states that at present there are not sufficient data to determine whether or not adult cells of the epididymis can give rise to malignant tumors. It appears that this is possible, at least for certain kinds of tumors. Tumors which simulate those characteristic of the testis may, and probably do, arise from fetal implants of cells from the testis. The clinical behavior of primary malignant tumors of the epididymis, especially carcinoma and sarcoma, is not characteristic of that of cytologically similar tumors when they occur in the testis. When both the testis and the epididymis are involved, clinical progress is more nearly like that of tumors of testicular origin. It is probable that any type of malignant tumor which is common to the testis may occur in the epididymis, but the frequency of occurrence is greatly reduced below that in the testis.

SPERMATIC CORD

Tumors.—Shivers [38] reports a case of primary rhabdomyosarcoma of the spermatic cord with secondary invasion of the epididymis and testicle. Only a few extratesticular myogenic tumors have been reported as invading the testicle, and their origin in most instances has been questioned. Myogenic tumors involving the testis should usually be considered as a one-sided development of a teratoid neoplasm; but in the case reported, from the observations at operation and the reports of pathologists, Shivers feels that he is justified in making a diagnosis of primary rhabdomyosarcoma of the spermatic cord with metastatic involvement.

PENIS

Trauma.—Roth and Warren [39] report 2 cases of traumatic avulsion of the skin of the penis and scrotum. They state that total, or nearly total, denudation of the penis is satisfactorily handled by the use of split thickness grafts, and this technic is facilitated by the use of the Padgett dermatome. In many cases of so-called complete avulsion of the scrotum, the avulsion is not actually complete in that small remnants of viable scrotal skin are attached somewhere to the margins of the wound. To ignore these small bits of scrotal skin is to ignore the almost incredible regenerative power of the scrotum, which makes possible a primary plastic repair. Primary plastic repair of the scrotum as described is technically easy, gives far superior anatomic results and eliminates the necessity for later time-consuming plastic reconstructions.

CHEMOTHERAPY

Penicillin.—Thompson [40] states that penicillin is a particularly valuable drug for the treatment of gonorrhea. The most practical method of administration is intramuscular injection of a solution containing 5,000 or 10,000 units per cubic centimeter. Doses of 20,000 units injected every three hours until 100,000 units has been given will result in cure in fully 98 per cent of cases.

Penicillin is unstable in solution, and at room temperature it rapidly loses its antibacterial power. Solutions should be freshly prepared and kept in the icebox between injections.

Penicillin is an extremely useful drug in the treatment of various nonspecific infections of the genitourinary tract. If the infection is caused by penicillin-sensitive organisms, the result of

37. Crabtree, E. G.: Malignancy of the Epididymis, with Report of a Case of Teratoma of the Epididymis, Tr. Am. A. Genito-Urin. Surgeons **36**:119-127, 1943.

38. Shivers, C. H. deT.: Rhabdomyosarcoma of the Spermatic Cord, J. Urol. **52**:266-274 (Sept.) 1944.

39. Roth, R. B., and Warren, K. W.: Traumatic Avulsion of the Skin of the Penis and Scrotum, J. Urol. **52**:162-168 (Aug.) 1944.

40. Thompson, G. J.: The Clinical Use of Penicillin in Genitourinary Infections, J. A. M. A. **126**:403-407 (Oct. 14) 1944.

treatment is excellent. In most cases, however, the infection is mixed and the result of therapy is not dramatic. Nevertheless, it is worth while. Administration of penicillin combined with other urinary antiseptics in these cases might well be superior to other methods of treatment.

The results of treatment in urologic cases can be determined well by repeated staining of the urethral or prostatic secretions or the sediment of the centrifuged urine with Gram's stain.

Treatment with penicillin is so devoid of toxic reaction that there is no reason to outline difficult schedules or to use complicated methods. The physician need not be fearful of using too much of the drug and should follow the dictum that the dose of any medicine is "enough."

Greenblatt and Street [41] state that penicillin is an effective drug for the treatment of chemoresistant gonorrhea in women. One hundred and nine patients received courses of penicillin therapy. Five hundred and fifty-one women were studied for venereal diseases, and for 61 per cent laboratory evidence to support the diagnosis of gonorrhea was obtained. During the period of observation in this series, treatment of 5 women with penicillin resulted in failure. A favorable response was obtained after a second course of therapy.

The dose of penicillin should not be reduced to the minimum necessary for good results. It should be maintained at a sufficiently high level so that the development of penicillin-resistant strains is thwarted. To this end it is recommended that 150,000 units be used, although good results may be obtained with as little as 60,000 units. The authors sound the warning note that there may be asymptomatic carriers and that penicillin-resistant strains of gonococci may appear.

Sternberg and Turner [42] state that studies have been carried out in fifteen selected Army hospitals with a view to determining as rapidly as possible time-dosage factors in the treatment with penicillin of gonorrhea which is resistant to sulfonamide drugs. A total of 1,686 patients refractory to at least two courses of a sulfonamide compound, and in some cases to artificially induced fever, were treated with total doses varying from 40,000 to 160,000 Oxford units per patient, the individual dose being 10,000 or 20,000 units administered intramuscularly every three hours.

These studies showed penicillin to be remarkably effective in the treatment of gonorrhea, usually causing symptoms to disappear and the results of bacteriologic cultures to become negative within forty-eight hours. One course of treatments effected cures in 98 per cent with a dose of 160,000 units per patient, in 96 per cent with a dose of 80,000 to 120,000 units and in 86 per cent with a dose of 50,000 units. No significant difference in the final results was noted when a given dose was administered in individual injections of 10,000 and in 20,000 units. Furthermore, little advantage was gained by prolonging the period of treatment schedules beyond twelve hours. Factors such as duration of infection, previous fever therapy and race appeared to have no effect on the results of therapy.

Of the 126 patients who failed to respond to one course of treatments with penicillin, 85 were given a second course, with a dose of 100,000 units. Of these patients, 78, or 91.8 per cent, were cured. Thus, with a second course of treatments 99 per cent of cures was obtained. No patient in the entire series proved to be resistant to penicillin.

Complications of gonorrhea responded well to penicillin, although the more serious complications required prolonged treatment with a larger dose. Reactions to penicillin were inconsequential, and in no instance was it necessary to discontinue treatment because of such a reaction.

Because of the known effects of penicillin on Treponema pallidum, the possibility of masking or delaying the development of early syphilis must be considered.

Finally, it should be recognized that the treatment of gonorrhea has been completely revolutionized in the past few years, first, by the introduction of sulfonamide drugs and, more recently, by the development of penicillin. It is clear that the management of gonorrhea now belongs within the sphere of the chemotherapeutist and that local treatment is rarely necessary, and may do more harm than good.

Sulfonamide Compounds.—McClelland [43] states that one of the hazards of the use of sulfonamide drugs is the development of anuria in a person who takes small doses. This condition may be serious, and an effort is being made to avoid it, if possible, or to correct it.

The problem which faces the urologist as soon as he sees a patient with anuria from any cause is to decide whether the anuria is a result of

41. Greenblatt, R. B., and Street, A. R.: Penicillin for the Treatment of Chemoresistant Gonorrhea in the Female, J. A. M. A. **126**:161-163 (Sept. 16) 1944.

42. Sternberg, T. H., and Turner, T. B.: The Treatment of Sulfonamide Resistant Gonorrhea with Penicillin Sodium: Results in 1,686 Cases, J. A. M. A. **126**:157-160 (Sept. 16) 1944.

43. McClelland, J. C.: Sulfonamide Anuria, Tr. Am. A. Genito-Urin. Surgeons **36**:133-137, 1943.

nonfunction of the renal parenchyma or of an obstruction, usually due to crystals, somewhere in the urinary passages. This will lead to distention of the renal pelvis and resultant pain and tenderness on the side of obstruction. If there is much distention, enlarged kidney may be felt. In cases of this type of anuria a ureteral catheter may be introduced to the area above the obstruction, with the result that the kidney increases its output of urine and the patient recovers. It is no great problem to decide whether there is distention of the pelvis. This can be ascertained by the presence of tenderness over the distended kidney. The ureteral catheter will relieve the distention. If by any chance the catheter cannot be passed to the distended renal pelvis, operation must be resorted to to relieve the distention. If one cannot be sure, one is justified in passing a ureteral catheter.

The intravenous use of sodium bicarbonate places an alkaline medium in the tubules of the kidney as an aid in dissolving any crystals of the sulfonamide drug which might be blocking the tubules in the kidney. It is known that the solubility of sulfadiazine and sulfathiazole increases rapidly as the p_H increases from 7 to 8.

In the department of pathology at the Banting Institute, in Toronto, slides of tissue were examined from similar cases in which death occurred after therapy with sulfonamide drugs. In 1 case the lungs, kidneys and spleen showed areas which were granulomatous and contained giant cells. One group of observers thought that these lesions were the granulomas of glanders, while another group stated that the granulomas were evidence of toxicity. In another case, in which a soldier who had treated himself for gonorrhea died of anuria, there were a small quantity of fibrinoid material in Bowman's capsule and eosinophilia in the interstitial tissue but no evidence of thrombosis. Thus, in these 2 cases the microscopic pictures of the renal parenchyma were different. The cause is thought to be a toxin, but what, one cannot say; nor do the fatal cases show a uniform picture.

McClelland reports a case in which the patient was given 30 grains (2 Gm.) of sulfathiazole and 150 grains (9.6 Gm.) of sulfapyridine in forty-eight hours. Anuria developed, and the patient died early, on the seventh day. The pathologic changes were not extensive, nor did they seem sufficient to cause anuria and death. The ureters and the tubules were not blocked with crystals.

Zide [44] reviews the histories in 10 cases, in which there were eleven renal reactions to sulfonamide drugs, one to sulfathiazole and ten to sulfadiazine. The minimal intravenously administered dose before renal symptoms occurred was 7 Gm. of sodium sulfadiazine. The minimal time before onset of renal symptoms was twenty-four hours. Two delayed reactions occurred, one six days and the other twelve days after administration of sulfadiazine was discontinued. During renal complications the urinary reaction to litmus paper was acid in 8 instances, alkaline in 1 and undetermined in 2. The sulfadiazine level of the blood ranged from 23 to 4 mg. per hundred cubic centimeters at or about the time of the renal reactions, the majority being over 8 mg. per hundred cubic centimeters. The treatment of all the patients in this series was conservative, with an unsuccessful attempt at manipulative treatment of 1 patient, who responded later to conservative therapy. The end results were cure of the original condition and the renal complications in all cases.

Ormond and Roth [45] state that recent reports indicate that the already wholesale use of sulfonamide drugs appears destined to increase. This is due not only to a wider application in the therapy of recognized diseases and to the development of new and more effective derivatives but to the use of these drugs in prophylaxis against infection. The authors review a few recent cases illustrating the nature of the dangers involved.

They say that there is irrefutable evidence that patients can be sensitized to sulfonamide derivatives and that the majority of the undesirable reactions occur in persons who have been sensitized by previous courses of the drug. This sensitization can be accomplished even by topical application of sulfonamide compounds.

From the point of view of pathologic lesions, three types of renal damage from sulfonamide drugs are recognized: first, frank obstruction, due to the deposition of crystals of the acetylated drug; second, widespread focal necrosis in which the kidney is only one of many organs involved in which renal obstruction provides the frequently fatal result; third, acute toxic nephritis in which focal necrosis and crystals are absent but in which anuria and uremia are the striking clinical features.

In respect to therapy, Ormond and Roth urge the early institution of intravenous administration of fluid, with appropriate use of a sixth molar solution of sodium lactate when acidosis is a factor and with administration of saline solution in accordance with the blood chloride

44. Zide, H. A.: Renal Complications of Sulfonamide Administration: Report of Reactions from Sulfathiazole and Sulfadiazine, J. Urol. **52**:275-282 (Sept.) 1944.

45. Ormond, J. K., and Roth, R. B.: Recent Cases Illustrating Dangers of the Sulfa Drugs, Tr. Am. A. Genito-Urin. Surgeons **36**:139-145, 1943.

values. The balance of the required fluids should be a 5 per cent solution of dextrose. Cystoscopic examination with ureteral catheterization and pelvic lavage with a warm solution of sodium bicarbonate should be undertaken when crystalluria is present and seems to be a possible cause of obstruction. Alkalinization of the urine with large doses of sodium bicarbonate given by mouth is likewise a rational procedure when crystalluria is present and seems to have been of distinct benefit in cases in which crystals played no part. Short wave diathermy of the kidneys has appeared to be a useful adjuvant in several cases. On theoretic grounds, diuretics which might possibly have a toxic action on the kidneys are contraindicated.

HERMAPHRODITISM

McIver, Seabaugh and Mangels [46] state that in the majority of the reported cases of true hermaphroditism the condition has been classified as bilateral and in the greater proportion of these cases the genitalia have presented. In these respects the condition in first of 2 cases reported was typical. It was atypical in that a tube and an ovary without a uterus were present. Also at variance with the usual findings were the union of the tube and the vas deferens and their termination in a blind fibrous cord, the vas deferens having no connection with the deep portion of the urethra. In 8 of the 13 cases reviewed the anomaly was bilateral. It was impossible in these cases to distinguish clearly between the testicular and the ovarian tissue of the two gonads.

A second case reported was not a typical instance of hermaphroditism. Except for the absence of the testis on the right side, the external genitalia were in a normal condition, which occurs rarely in cases of this type. The tube, present on the right side, was involved in an infectious process, which produced acute episodes in the right lower quadrant of the abdomen and presented a pyosalpinx at the time of removal. These features appear to be unique, for a review of the literature did not reveal any similar instance. This case, in McIver, Seabaugh and Mangels' opinion, should be classified among instances of true lateral hermaphroditism. It is unfortunate that no pathologic evidence was available to confirm this contention. The finding of live motile sperm in the ejaculated fluid established the presence of active testicular tissue, but it did not preclude the presence of ovarian tissue also.

46. McIver, R. B.; Seabaugh, D. R., and Mangels, M., Jr.: True Hermaphroditism: A Report of Two Cases, J. Urol. **52**:67-85 (July) 1944.

INFECTIONS OF THE URINARY TRACT

Cook [47] calls attention to an interesting, but small, group of patients with infection of the urinary tract. Repeated stains and cultures of the urinary sediment from patients with this type of infection repeatedly yield negative results. The symptoms of this type of infection are the same as those of the more common bacterial infections of the urinary tract, but usually more severe. Examination of the urinary sediment and cystoscopic study reveal definite evidence of infection. Rarely is there an associated renal condition, but it has been found in some instances. Because of the existence of pyuria without demonstrable organisms in the smear, this clinical entity has frequently been confused with tuberculous infection. It goes without saying that a diagnosis of tuberculosis of the urinary tract should never be made on the basis of the presence of sterile pyuria alone, without corroborative evidence of an infection with acid-fast organisms.

The treatment of infection without demonstrable organisms is almost specific. The usual chemotherapeutic agents, such as mandelic acid and the sulfonamide drugs, are of little value. Arsenical preparations, given intravenously, are most useful, and usually two or three doses of neoarsphenamine (0.2 to 0.37 Gm.), given five days apart, will sterilize the urine. In a number of instances removal of foci has contributed greatly to the clearing up of such infections. The relationship seems definite, as frequently the removal of foci brings about a temporary increase in symptoms.

Helmholz,[48] in an editorial on treatment of infections of the urinary tract in childhood, states that recognition of bacteria as the cause of these infections penetrated rather slowly into the practice of pediatrics and urology. The first micro-organism causing an infection of the urinary tract in childhood was isolated by Escherich; it was a colon bacillus, which under the accepted bacteriologic nomenclature is known by the name of Escherichia coli. Later it became evident that a number of bacteria can produce infections of the urinary tract, that these bacteria differ in their susceptibility to various antiseptics and that different strains of the same micro-organism may do so.

Earlier, acidification and alkalinization of the urine were advocated for the treatment of pyelitis. With the aid of determination of the

47. Cook, E. N.: Infections of the Urinary Tract Without Demonstrable Organisms, Proc. Staff Meet., Mayo Clin. **19**:377-380 (July 26) 1944.

48. Helmholz, H. F.: Treatment of Urinary Infections of Childhood, editorial, Surg., Gynec. & Obst. **79**:557-558 (Nov.) 1944.

hydrogen ion concentration, it was shown that a p_H of 4.6, on the acid side, or of 9.0, on the akaline side, was necessary to sterilize urine infected with a given colon bacillus. With the introduction of methenamine as a urinary antiseptic the importance of the hydrogen ion concentration of the urine became emphasized. Methenamine itself is without bactericidal power, but when the hydrogen ion concentration falls to 5.5 or less, formaldehyde is liberated and displays bactericidal potency.

Often no attention was paid to the necessity of acidifying the urine sufficiently, and then the medication was not successful. With acidification, the dose required produced irritation of the bladder in some cases, with hematuria.

Helmholz and Clark introduced the ketogenic diet for the treatment of infections of the urinary tract. Betaoxybutyric acid is excreted by the human kidney in high enough concentrations to sterilize the urine when it has the proper p_H. The lower the p_H, the lower is the concentration of the acid necessary to kill bacteria. The introduction of mandelic acid made it possible to give an organic acid by mouth, rather than to produce it by means of a high fat diet. Mandelic acid, too, is bactericidal only at a p_H of 5.5 or less in concentrations in the urine which can be achieved without danger of renal irritation.

The most recent addition to the urinary antiseptics is the group of sulfonamide compounds. Their rapid excretion, even by the damaged kidney, their action in acid and alkaline urine and their bactericidal action when given in small amounts which are not likely to produce renal damage make them the urinary antiseptics of choice. However, the great drawback of the entire group is their lack of action on infections with Streptococcus faecalis.

This fact has introduced for the first time the necessity of determining the nature of the infection. Hitherto, certain bacteria might be slightly more resistant than others but could be inactivated by slightly longer treatment or by increase in the dose. Str. faecalis grows luxuriantly in urine containing one of the sulfonamide compounds in concentrations which will kill the usual gram-negative bacilli. Since the introduction of the sulfonamide compounds it has been realized how frequently mixed infections with gram-negative bacilli and Str. faecalis exist; initial cultures may show apparently pure cultures of gram-negative bacilli, but after several days' treatment with one of these drugs pure cultures of Str. faecalis may be found.

Of the sulfonamide compounds, sulfathiazole or sulfadiazine is the drug of choice for all infections but that due to Str. faecalis. For infections with Str. faecalis mandelic acid is the drug of choice. This leaves without adequate treatment only infections with Str. faecalis in patients who have damaged kidneys, since neither the required p_H nor the required concentration of the drug may be obtainable.

MALE CLIMACTERIC

Heller and Myers[49] discuss the symptoms, diagnosis and treatment of the male climacteric. The diagnosis of the male climacteric was established in 23 cases by the finding of pronounced elevation in excretion of gonadotropin, comparable quantitatively to that occurring in castrated men. This was corroborated in all 8 cases in which biopsy was done by histologic evidence of testicular atrophy and degeneration. The diagnosis was further supported by a specific response to a therapeutic test with testosterone propionate in all 20 patients so treated.

A clearcut differentiation of the male climacteric from psychogenic impotence was made by assays of urinary gonadotropin, which was decidedly elevated with the former condition and normal with the latter. A simple therapeutic test is helpful in distinguishing between these two conditions.

The symptoms of the male climacteric are different from those of psychoneurosis and psychogenic impotence. Satisfactory therapeutic results were obtained with intramuscular injections of testosterone propionate and with implantation of pellets of testosterone but not with oral or sublingual administration of methyl testosterone.

Although the male climacteric may occur as early as the third decade, it is a relatively rare syndrome, probably affecting only a small proportion of men who live to old age.

ANEURYSM AND URINARY SYMPTOMS

Lazarus and Marks[50] state that aneurysms of the abdominal aorta can, and frequently do, give rise to urinary symptoms, which may be so predominating as to mask completely those produced by the aneurysm. In most of the reported cases the condition has been mistaken for nephrolithiasis, perinephric abscess or hydronephrosis. The most frequent roentgenographic findings suggestive of aneurysm are renal or ureteral displacement and erosion of bone. Lateral roentgenograms are invaluable in demonstrating these conditions. The outstanding symptom of aneurysm of the abdominal aorta is severe pain,

49. Heller, C. G., and Myers, G. B.: The Male Climacteric: Its Symptomatology, Diagnosis and Treatment, J. A. M. A. **126**:472-477 (Oct. 21) 1944.

50. Lazarus, J. A., and Marks, M. S.: Aneurysm of the Abdominal Aorta Associated with Urinary Symptoms, J. Urol. **52**:115-125 (Aug.) 1944.

frequently simulating renal colic, which does not respond to the usual remedial measures and is aggravated by postural changes. Pain is usually due to erosion of bone and pressure on nerve roots. True renal pain may exist, however, in which event it is due to interference with renal drainage or to renal infarction or to both.

Since the two outstanding causes of aneurysm of the abdominal aorta are syphilis and atherosclerosis, routine Wassermann tests on the blood of all patients should be made and anteroposterior and lateral roentgenograms carefully searched for calcareous shadows adjacent to the renal silhouette.

Dissecting aneurysms are most likely to give rise to severe renal symptoms. Renal exploration, particularly when performed on the left kidney, should always include thorough inspection of the renal pedicle. Any suspicious tumefaction in the renal fossa, especially when presenting a bluish discoloration, should never be incised before its true nature is ascertained by aspiration and palpation for thrill. Treatment directed to the relief of renal symptoms resulting from aneurysms of the abdominal aorta should be conservative.

Lazarus and Marks report a case of aneurysm of the abdominal aorta of atherosclerotic origin with urologic symptoms in which the aneurysmal sac, although misinterpreted on the roentgenogram, was clearly recognized at operation and on subsequent roentgenograms.

ROENTGENOLOGIC ASPECTS OF UROLOGY

Arens [51] discusses the roentgenologic aspect of the urologic problem. He states that proper and adequate preparation of the gastrointestinal tract is a prerequisite to satisfactory roentgenographic examination of the urinary tract. An ideal roentgenogram of the urinary tract is one which shows the details, including the outlines of the kidneys. The kidneys are too often obscured by material in the gastrointestinal tract, which may be so dense as completely to vitiate shadows due to stone.

Failure to visualize a urinary calculus on films of the kidney, ureter and bladder does not signify that a stone may not be present. There are radiolucent calculi that cast no shadow. Even a large calcific ureteral stone may not register a shadow on the film when it lies over the ala of the sacrum. A scout film of the urinary tract is usually only the first step in a proper roentgenographic examination.

There is no controversy between excretory urography and retrograde pyelography. Examination by either one method or the other, with a scout film or with all three combined, may be necessary before a satisfactory result can be obtained. It is as important to visualize the normal renal pelvis as the pelvis of the suspected kidney.

A suspected shadow of stone, apparently in contact with a catheter in the roentgenogram, may prove to be outside the ureter or the kidney when rotation films are made. Shadows of stone in the right upper quadrant and within the outline of the kidney should not be judged too hastily. They may prove to be gallstones.

Absence of excretion (excretory urography) from one kidney does not necessarily mean a "dead kidney." A small stone in the ureter may produce calculous anuria, even though the stone may not be visualized. It has been noted that renal function was restored within five minutes after a ureteral calculus was passed into the bladder.

With reasonable precaution, excretory urography, in experienced and competent hands, is a safe and valuable procedure, and one which frequently gives information obtainable in no other way.

RECTOURINARY FISTULA

Wilhelm [52] states that rectourinary fistulas due to trauma or acute inflammatory disease frequently heal with conservative treatment. On the other hand, fistulas which are caused by a neoplasm offer a grave prognosis.

Chronic rectovesical and rectourethral fistulas are best approached and repaired by the perineal route. The fistulous opening in the rectum can often be exteriorized and excised with the redundant mucous membrane. If this is not feasible, the freshly sutured defects in the bladder and rectum should be separated by an interposed wedge of the muscle. The rectal sphincter can safely be used for this purpose.

Suprapubic cystostomy is indicated prior to radical reparative operation. On the other hand, preoperative administration of succinylsulfathiazole enabled Wilhelm to abandon preliminary colostomy as a routine measure.

51. Arens, R. A.: The Radiologic Aspect of the Urologic Problem, J. A. M. A. **126**:605-607 (Nov. 4) 1944.

52. Wilhelm, S. F.: Rectourinary Fistula, Surg., Gynec. & Obst. **79**:427-433 (Oct.) 1944.